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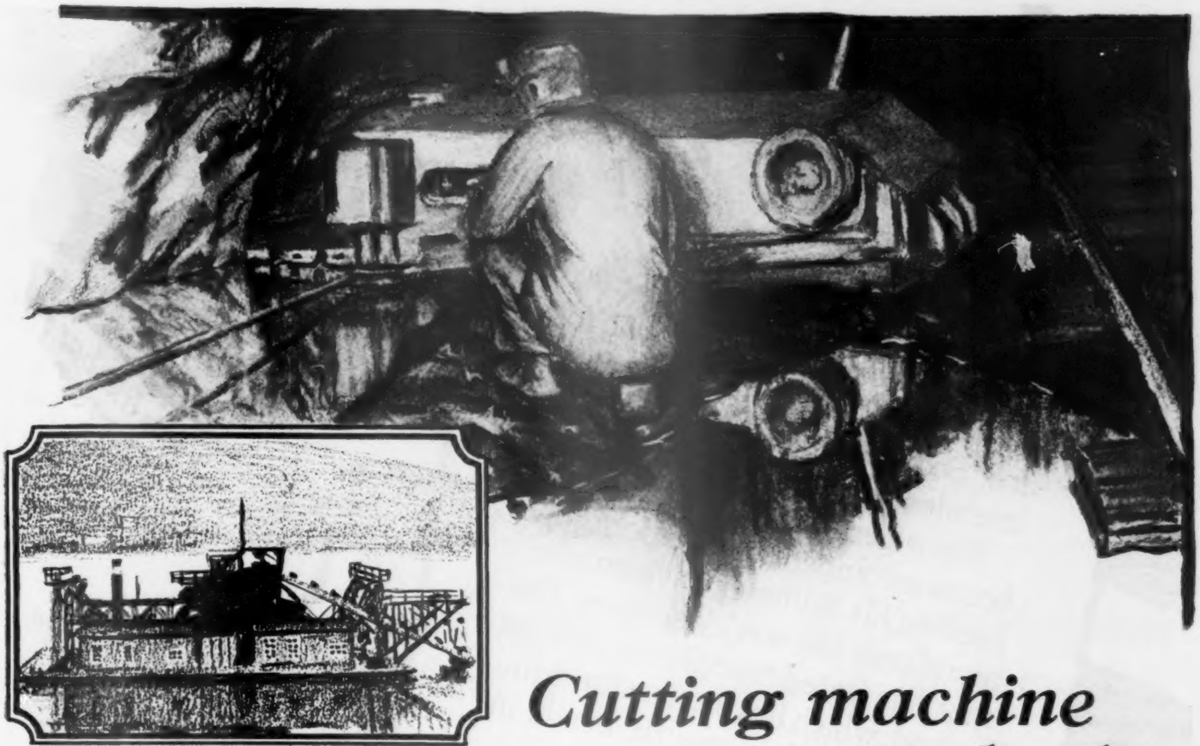

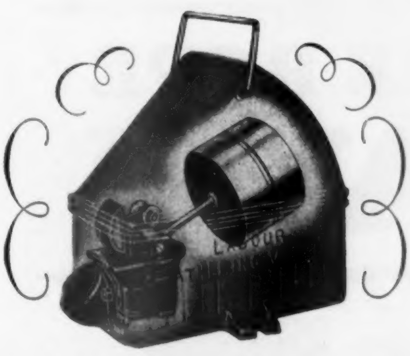

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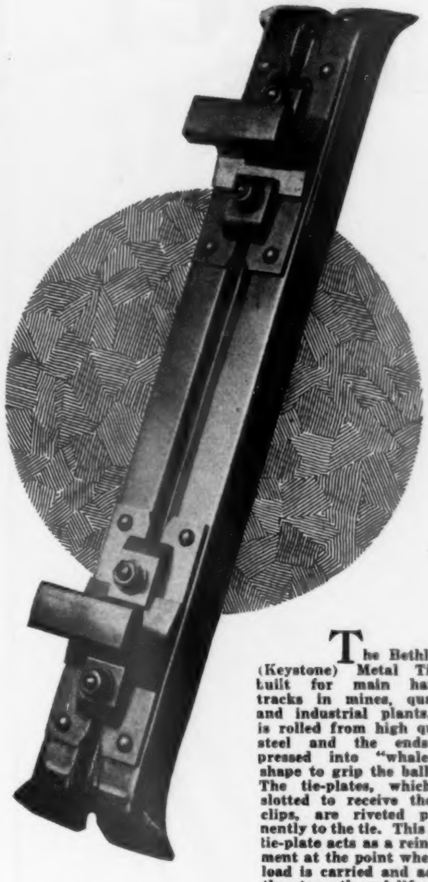

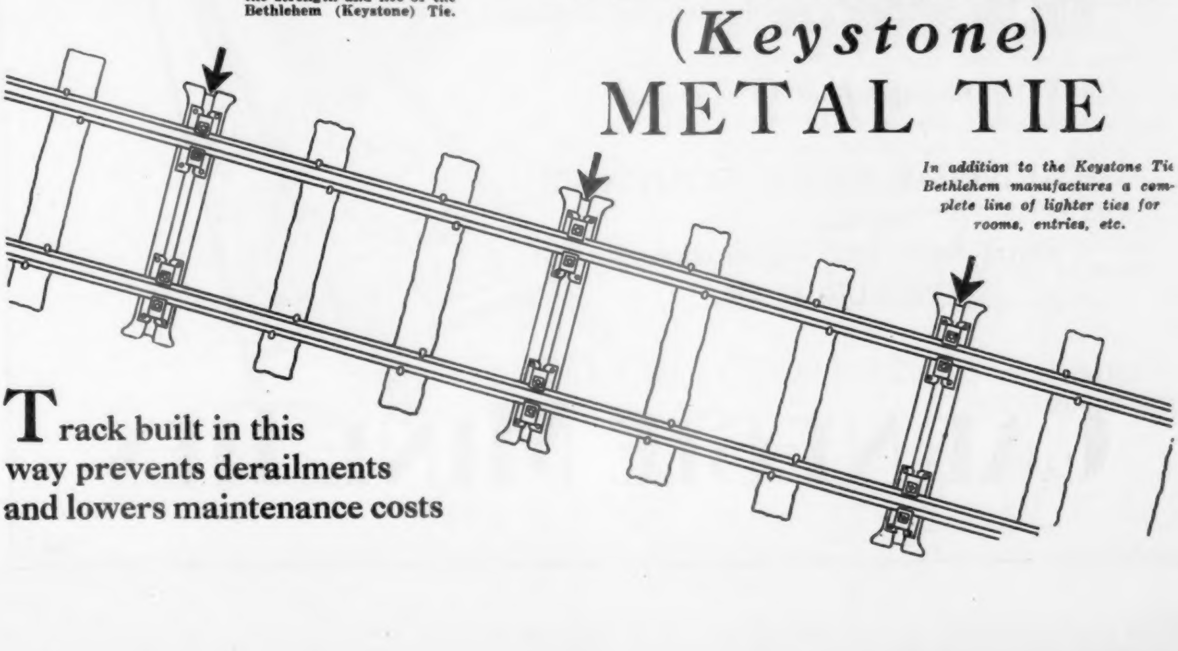

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The
MINING CONGRESS JOURNAL

**A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress**

VOLUME 15 MARCH, 1929 No. 3

Editorials

The Coal Industry At Cincinnati

THE American Mining Congress has announced the dates for its annual meeting of Practical Coal Operating Officials, and has selected the members of the Program Committee to cooperate in arranging the program for this important meeting. The week of May 13 has been selected, and Cincinnati will again be host.

Mr. Paul Weir, Bell & Zoller Coal and Mining Company, is chairman of the Program Committee, which is composed of 60 representative coal men. The first meeting of the committee was held recently in Pittsburgh and a program of unusual merit has been tentatively arranged.

The response from the industry to a questionnaire seeking to learn the topics of foremost importance at this time, indicate in very definite manner that the progress in mechanized mining, coal cleaning and safety are preeminent. The program therefore has been built around these three major topics.

In previous years special days have been set aside for the discussion of special topics, such as coal cleaning, power and transportation, safety measures, etc. This procedure has been abandoned for the 1929 meeting, and each session has been arranged to cover the entire range of production from face to railroad car. Each session will present papers upon drilling, blasting, cutting, loading, power, cleaning, and management problems. In only one instance has this method been abandoned and that is in the case of safety, when one entire session will be devoted to that specific subject. The committee also has arranged to present the sessions in such a manner that the problems of one producing district may be featured. For instance, a delegate attending the meeting but for two days, may learn what is being done in four major producing districts, not alone in mechanized mining, but in every phase of production. This arrangement gives the delegate more time for inspection of exhibits, and does not compel him to concentrate upon one subject for an entire session. If he is interested only in mechanized mining, in a period of two days he may learn what is being done in Illinois, Indiana, Ohio, Pennsylvania, Alabama and the far west. He has an opportunity to listen to other related discussions if he desires, and to renew acquaintance with his friends.

This procedure is entirely new and experimental. Mr. Weir and his committee believe that it will eliminate some points of criticism, and will simplify the committee's problem of covering a lot of ground in a few hours time.

These meetings at Cincinnati have become the mecca of all those who wish to keep fully informed on progress in coal production. At no other meeting is there such an opportunity to get such a wide-spread picture of the advancement of the industry. These meetings are pointing the way to lower production costs, increased efficiency, and safety in coal production; they have brought about a unity and cooperation within the industry that is encouraging, and sure to bring big results. They are building, and building firmly, the future of the coal industry.

The New Income Tax Regulations

WHILE the general text of the new income tax regulations just issued by the Treasury Department, is not changed materially from that of the prior regulations, it is believed the arrangement, which follows the arrangement of the provisions of the revenue act of 1928, is much improved.

Taxpayers have in the past experienced considerable difficulty in finding easy reference to all the provisions of the regulations bearing on all questions involved in the preparation of their returns. With the new arrangement of the regulations, which is comparatively easy to comprehend, and the improved table of contents and complete cross-index, it is believed taxpayers will find their reference work in connection with their returns considerably simplified.

If this proves true, it is an important step toward simplification of income tax procedure, and will result in the elimination or avoidance of many minor errors and controversies, and thus will expedite the administrative work of audit and review both in the collectors' offices and in the income tax unit in Washington.

A number of important amendments to the regulations, recommended by divisions of the income tax unit, and designed to clarify or modify existing practice and procedure dealing with certain technical problems and difficulties, for example, such as are involved in mine valuations, were passed over for further study. If approved, these will be promulgated, as amendments to the new regulations, by Treasury decisions.

The preparation of these regulations involves a tremendous amount of work and careful study, and also a large responsibility to both the Government and the taxpayer. The officials charged with this responsibility and task are to be commended for the excellent results exemplified by the finished product—Regulations 74, a volume containing 463 pages.

The Tariff Hearings

FOR nearly two months the Committee on Ways and Means of the House of Representatives has been holding hearings on the tariff situation that has existed under the tariff act of 1922 and the present needs of American industries. The public interest in these hearings has been tremendous. Practically every industry in the United States and every business interest has been represented. Nearly everyone is asking for something more or different than is provided under the 1922 act. Those seeking tariff changes may be classified as follows:

(1) The producers of raw materials that are not now adequately protected against foreign competition as is clearly demonstrable from a study of imports and the ability of the domestic producers to economically supply the domestic market.

(2) The producers of fabricated products who are seeking additional protection or readjustments that will make the tariff fully effective as to their products, and who are not opposing proper increases and readjustments in cases of domestic raw materials used by them.

(3) Producers of fabricated products who are seeking higher rates on everything they sell and ask that the raw materials they buy be placed and kept on free list.

(4) Importers and their agents who would suffer a loss of business and profits from importations to the extent that tariff protection gives to the domestic producers the American markets.

Adequate Protection

GENERALLY speaking, producers of raw materials are engaged in the basic industries of mining and agriculture. There can be no question but that some of the weaker branches of the mining industry failed to receive in 1922 the protection required and justified by the facts submitted. However, in most cases these industries have made progress under the inadequate protection granted. They have kept faith with their Government, and it is incumbent upon the Government to now grant them the protection they merit. The same is undoubtedly true of some branches of the agricultural industry. Upon these basic industries is built the economic structure of the Nation. Unless they are producing at somewhere near their capacity there is a slowing up of production and a falling off in volume in all lines of business.

The manufacturer who seeks further protection and who desires to see proper protection given to the domestic producer of the raw material he uses, and who can show a legitimate reason for the protection he asks, should receive most careful consideration. His position is sound. His attitude is fair. His tariff policy is consistent. It is unnecessary to point out that unemployment is most distressing when there is depression in our great manufacturing industries. Therefore, adequate tariff protection is as vital to the welfare of the American worker as it is to the American investor and the business structure generally.

Inconsistent Demands

THE manufacturer who seeks protection for his products, but desires to have placed on the free list the raw materials he uses so that he can obtain his supplies from foreign sources instead of from domestic producers, and thus increase his margin of safety and profits in expanding his markets and meeting competition, should not be denied the protection he requires, notwithstanding the inconsistency of his policy and his disloyalty toward his fellow domestic producers of raw materials; but his representations in opposition to the request of the latter should receive no consideration whatever. Such an interest is entirely biased and selfish. If protection could be denied such an interest without jeopardizing the tariff and economic structure, Congress would be justified in placing the products of such people on the free list.

Of course, the importer should receive little consideration in so far as his opinions and representations are concerned with imported products which can just as well be produced in sufficient quantities to supply the American markets. His interest is a selfish one. His profits, in so far as they accrue from importations that take away the markets for domestic production, come out of the pockets primarily of the American workingman, and secondarily the promoters and operators of the domestic industries affected. Therefore, the opinions of the importers can be of little help to Congress.

How Much Readjustment Is Needed

AS TO the question of how much tariff readjustment is required at this time, we believe it is safe to follow the policy that the basic industries should receive first consideration, and should receive increased tariff protection to the extent that they are able to show their ability to supply the requirements of the American consumer; that the protection granted shall be based upon the difference between cost of production at home and abroad so that the importer will be placed upon an equality with the domestic producer in the American markets; that growing infant industries shall be granted such protection as will enable them to develop rapidly and to the largest possible extent, with reasonable assurance that such protection will be continued for the time necessary to accomplish the full development of such industries. Congress shall not be expected to increase tariffs and make readjustments that are solely for the purpose of increasing the profits of an industry that is already enjoying substantial profits from domestic production. If these considerations are followed in framing the new tariff bill, we believe tariff legislation will meet the entire approval of the American people. It is to this task that the special session of Congress must devote itself.

The Shipstead Anti-Injunction Bill

THIS bill would curtail the power and jurisdiction of the Federal courts in dealing with labor disputes. In the past it has been necessary for property owners to protect their properties from damage and destruction by securing injunctions against those who, under the cloak and cover of an organized strike, would trespass, damage and destroy property; and for employers in industry to protect their loyal employes from abuse, coercion, intimidation and injury by organized strikers. It is believed that but few instances can be found where the Federal courts have abused their powers in granting injunctions for the protection of life and liberty, private rights and property.

The pending bill states that "the individual unorganized worker is commonly helpless to exercise actual liberty of contract and to protect his freedom of labor"; that he should have "full freedom of association, self-organization, and designation of representatives of his own choosing to negotiate the terms and conditions of his employment"; and that, therefore, he should "be free from the interference, restraint, or coercion of employers." And this is declared to be "the public policy of the United States."

Now what does this bill propose to do to establish that principle; and does it, in fact, safeguard the rights of "the individual unorganized worker," his "freedom of labor," his "full freedom of association, self-organization," and his right to "negotiate the terms and conditions of his employment"? It forbids the issuance of any injunction in a labor dispute except where actual violence and fraud has been committed, and then permits only injunctions against such acts. Boycotting, sympathetic strikes, mass picketing, intimidation, coercion, and other strike methods for the purpose of imposing the will of one class upon another or others, and for the purpose of compelling the acceptance of the demands of one class by another under the threat of business and financial disaster, loss of markets, or other irreparable damage, could be carried on without fear of injunctive restraint.

This is not all. The bill gives all sorts of special privileges to the labor unions. There appear to be left by the bill no safeguards for the individual worker who elects not to join the union, or the group of workers who elect to organize and maintain an association independent of the union, or the business or industry whose employes elect to remain free from union influence, or the employer who elects, as he has the right to do, not to employ union labor, or the public whose welfare depends upon the orderly conduct of business and industry, the uninterrupted production and flow into the channels of commerce and distribution of the necessities of life, and stability of the economic structure of the Nation.

Thus this bill contradicts the very policy it declares. It unquestionably is unconstitutional in some of its major features. It should be protested by every liberty-loving American citizen. How organized labor has flaunted the law of the land in the past, how workers have been intimidated, employers coerced, property destroyed, business interrupted, and even murders committed, are matters of common knowledge. This bill would permit oppressive union combinations and coercive union activities without restraint, and would remove practically all barriers of law that now safeguard the rights of American citizens.

The Value Of The Bureau Of Mines

THE United States Bureau of Mines is the only representative of the mining industry in our governmental system. It deserves the support and cooperation of every branch of the industry. But it has not had either in the measure it must have if it is to be the effective force it should be.

The Bureau has been handicapped by the usual lack of funds; by the usual government red-tape; by the lack of cooperation from those it seeks to serve, and by its own limitations. But that is only saying the obvious, and does not change the situation. What should be done to bring about a better understanding between the Bureau and the Industry? Its appropriations have been cut still further for 1929, thus increasing its handicap. It is time that something be done about it.

There is no real reason for the cut in the appropriations, except the apathy from the industry itself. There is some feeling in the industry that the Bureau is developing a tendency to become a dictator in its affairs, rather than a cooperator in solving its problems. Therefore, when appropriations are up for discussion, there has been no demand upon Congress from the producers to increase the funds. Perhaps this apathy is responsible for the fact that agriculture receives $33 for every dollar appropriated to assist mining.

The present cut in appropriations will go far in preventing the Bureau continuing much of its effective work, and will prevent it undertaking anything new.

The Bureau is not all that it should be. But it is not altogether the fault of the Bureau that this is the case. If the industry will get behind Director Turner and his staff, tell them what the industry wants and needs, and cooperate in making it possible for them to do it, there will be a very different story to tell. It is high time that whatever underground current of criticism against the Bureau exists, be brought to the surface. It is time that the industry itself begins to understand what the Bureau means to it; what it is doing for it, and how its services may be utilized. If the Bureau is unsatisfactory to some branches of the industry let us get together and make it what we want it to be.

In spite of criticism individual or sectional, the Bureau of Mines has done and is doing much good work for the mining industry. It is the national representative of the industry. That industry should be 100 percent cooperative with it, if it expects it to be 100 percent effective.

Statistics And Their Interpretation

IF THE Bureau of Mines had done nothing else for the coal mining industry, the statistics it has prepared each year on the production of coal with mechanized loading would have been a big thing.

The figures above referred to have shown the number of mines using mechanized loading equipment, the number of machines in operation and the tonnages produced. These figures, in themselves, are particularly interesting to the coal industry. However, their value has been greatly increased by the very able interpretation and analysis which was made last May by Mr. F. G. Tryon and presented during one of the meetings of the Annual Convention of Practical Coal Operating Men, under the auspices of The American Mining Congress.

This work of the Bureau has well merited the approval of the industry, and it should by all means be continued and the information so gathered given to the industry without delay. There is no better way in which the growth of mechanical mining can be determined than through the compilation and correct interpretation of accurate figures.

The National Committee on Mechanized Mining of The American Mining Congress desires the cooperation of the Bureau in its work, and has found Mr. Tryon's statistics especially valuable. The mining industry should cooperate with the Bureau in the gathering of these statistics, and should encourage it in this important phase of its work.

Information Circulars

DIRECTOR TURNER recently announced a new service of the Bureau in behalf of the metal producer, which involves the preparation of a series of papers on the application of the various mining methods in metal mines, to be known as "Information Circulars." In this work the cooperation of the operator will be sought, and the papers presented by the men in charge of the particular mining system in question, acting with the Bureau in a consulting capacity. The first of these papers was "Method and Cost of Mining Magnetite in the Mineville District, New York," and was presented in cooperation with Mr. A. M. Cummings, general superintendent for Witherbee, Sherman & Company.

The dissemination of this type of information will be of great value to the mining industry, and certainly will bring the Bureau closer to the industry it represents.

The Anthracite Tax

WHEN the Pennsylvania Legislature imposed a tax on anthracite, it did so to overcome a treasury deficit. Whether such a procedure was right or wrong is not the province of this editorial, but assuming the political expediency of it, the deficit has now been met, and the state treasury is flush with a surplus of some $30,000,000. The need has been met, the anthracite industry has paid the penalty, and it should be relieved from further injustice.

Such a tax is against the record of the great State of Pennsylvania, a state which contains more acreage, more population, more accumulated wealth and more natural resources than many of the independent nations of the world. As a state it has consistently supported a protective tariff for so many years that a different position can not be recalled. It has become a great commercial and industrial division under this protective tariff system, which primarily equalizes competition with foreign countries. In spite of this record, the legislature of Pennsylvania, a few years ago, reversed its position by enacting an idiotic law which has prevented one of her largest industries from fair competition in outside markets.

An effort is being made to induce the legislature of Pennsylvania to repeal the anthracite coal tax which is gradually forcing a curtailment of the use of anthracite in competition with oil and gas as a domestic fuel. Leaving aside all discussion of the justice of such a special tax, levied against a special industry, it must be patent that anthracite can not pass this tax on to the consumers as against the competition which it must meet in its outside markets.

The production of anthracite has been on the decline under the provisions of this special burden. The ability of this industry to pay other taxes is being gradually and inevitably curtailed. The facts involved should convince the legislators of Pennsylvania of the inconsistency of such a tax, to say nothing of its injustice. It would be futile to undertake an estimate of what increase in such tax would entirely annihilate the industry. A comparison of present with past production indicates the extent to which the industry is now being hampered. It can not be supposed that the State of Pennsylvania could be benefited by wiping out so important an industry and if the political principles which Pennsylvania has maintained all through the years are of any value, they should argue for the immediate repeal of the special anthracite coal tax which in effect is an embargo against anthracite shipments to natural markets.

The greatness of Pennsylvania as a state is absolute proof of the advantages of protection of home industry rather than protection of markets in favor of competing industries and such is the anthracite coal tax.

Policing Industry

WHILE industry and leaders in economic thought are repeatedly advocating some change in the anti-trust laws, if not their complete repeal, the Federal Trade Commission, watch-dog of legitimate trade practice, has renewed its old effort for greater power. Compelling industry to make public intimate details of its methods seems to be one of the outstanding desires of the commission. Repeatedly it has attempted to force certain industries to submit monthly reports of their costs of production. So far it has been unsuccessful.

The recent report of the commission to the Senate on its investigation of open price trade associations asks for Federal legislation to compel the return of monthly statistical data from all manufacturers and dealers, the licensing of trade associations, and that the anti-trust laws be clarified or extended to cover the circulation of identified price and statistical information. Such authority would be vested in the Census Bureau.

There is, of course, no likelihood of any legislation of this character being enacted at the special session. But the proposal indicates that the Federal Trade Commission has not recovered from its original belief that industry needs a policeman. In proposing this legislation the commission is running true to form of many bureaus, commissions and independent boards. They are never willing to stay within their legal limits and continually seek greater authority.

The present attempt is doomed to failure, if for no other reason than that the President of the United States is unalterably in favor of cooperative effort in industry, as evidenced through his administration as Secretary of Commerce, and because such a precedent would bring an avalanche of criticism, complaint and protest down upon the political body in Washington.

Control Of Production

ONE of the most recent statements advocating a widening, instead of a tightening, of the anti-trust laws, was made by Prof. W. H. Hamilton, of the Yale Law Faculty, at the recent meeting of the American Institute of Mining and Metallurgical Engineers, who said:

"The attempt to preserve competition results in increased overproduction and a plague of bankruptcies and reorganizations which makes it impossible to have decent standards of living. A definite control of production is necessary if industry is to do what we want it to do, and that is to provide consumers with low prices and laborers with high wages.

"However, I should hesitate to have the Sherman act repealed unless we could put some other responsible instrument in its place. To repeal the act would be a serious danger to the interests of stockholders, laborers and consumers alike. The art of production has been revolutionized by technology. We need a similar constructive attack on the problem of organizing in industry."

Mexican Immigration

THE proponents of legislation to restrict immigration from Mexico have been unsuccessful in their attempts to have their pleas considered at this session of Congress. This is as it should be. With a new administration coming in this important question should be left for it to handle. Unquestionably, immigration restriction legislation at this session or even discussion of the subject on the floor of either House of Congress would have proved embarrassing to the incoming administration.

President Hoover, as the result of his visit to South American countries, has created a feeling of confidence and good will throughout these republics toward this country. This will be demonstrated by an increase in the exportation of American products to South America during the next four years. This will mean further improvement in employment conditions in this country, and will contribute to the prosperity of American business generally. It also will contribute to the prosperity

of the South American countries because the increased use of improved agricultural and manufacturing machinery and equipment in these countries will be reflected in increased production in South American industries.

Our European competitors in this South American trade would have been pleased to see this Congress take up the immigration restriction measure, and would have benefited by the application of the quota law to Mexico and other South American countries. There is no immigration problem except in relation to Mexico; but it would be difficult, if not practically impossible, to apply a restrictive measure against Mexico alone. Mexico would resent this discrimination in favor of other republics of the western hemisphere. Retaliatory measures affecting American investments, employment, and travel in Mexico, as well as commercial relations with that republic, undoubtedly would follow the enactment of such legislation.

The contentions of the proponents of immigration restrictions against Mexicans that increasing numbers of undesirables are taking up permanent residence in various sections of the United States; and that they are competing at low wages with American workers and thus contributing to the unemployment situation, are not well founded. Practically all of the testimony given to the immigration committees of the House and Senate has been to the effect that Mexican labor is seasonable and returns to Mexico at the conclusion of a season's employment, and that this labor is used only when native labor can not be secured.

There is a sort of check upon incoming Mexicans but practically no check upon the numbers that return to Mexico. It would seem, therefore, that before any legislation is seriously considered, the United States Government should make an exhaustive investigation of the situation. A census should be taken of the number of Mexican citizens permanently residing in this country, and the return as well as the influx of seasonal laborers should be carefully checked for a period sufficient to determine the facts.

Our Foreign Trade

EUROPE, Asia, and South America need mining, manufacturing and agricultural machinery, and mechanical equipment of every kind. Russia is perhaps in greatest need at the present time, owing to her vast population, far-flung domain, and wholly inadequate system of transportation. A great awakening is taking place in Russia. The Soviet may or may not be responsible for this awakening, but it has been made possible by the removal of institutions and conditions that kept the Russian peasantry yoked with ignorance, superstition and dread. Russian peasantry now is beginning to realize that a new world of mechanically-operated mines, mills, factories and farms, artificially-watered crops, and of public schools is not only his to see from afar, but his to have and enjoy.

South America is rapidly growing more important as a market for mining and agricultural machinery and other mechanical equipment. Competition for this market between American and European manufacturers is keen. Relations with the South American countries are cordial. Americans have been steadily increasing their commercial activities and investments in these countries and are welcomed by both governments and peoples. The Departments of State and Commerce, and the United States Shipping Board have been helpful agencies in the promotion of this foreign trade. The experience of these agencies and the development of definite policies with reference to South American trade are certain to enlarge the possibilities of trade expansion.

Thus an era of industrial prosperity, probably greater than the expectations of the most optimistic of our industrial and economic analyses, appears in the offing. Ways and means doubtless will be found in the near future for dealing with the Russian situation in a manner that will be satisfactory to our people, consistent with the principles that the Soviet government thus far has refused to recognize. Russia needs America's trade as well as American capital and American machinery. Conditions are rapidly approaching a stage where the resumption of trade relations must be brought about by a friendly accord between the Russian government and the United States. President Hoover understands the situation. It has been his business to develop commerce. He is familiar with the diplomatic progress that has been made. He undoubtedly will strive, with all of the powers at his command, to mold conditions that will enable this country to take the lead in developing the business and trade of the world.

The National Exposition

THE 1929 National Exposition of Mining Equipment to be held in conjunction with the Convention of Practical Coal Operating Men, under the auspices of the Manufacturers Division of The American Mining Congress, promises to outdo all previous expositions. More actual operating equipment is to be shown, and a larger variety of equipment generally will be on display. Practically all of the manufacturers of mechanical loading equipment will have on display their newest machines; the electrical, transportation, pumping, coal cleaning equipment folks will be there in full force. The exhibits apparently will be live and active.

The management has made a special effort to segregate the noisy and quiet exhibits, and to distribute the operating exhibits between the two halls, thus distributing the noise and giving better opportunity for comparison of exhibits.

The Exposition will be entirely on the ground floor, and the meetings of the Convention will all be held in the theater which is immediately between the two halls. This insures that the sessions will be free from noise, and in order further that all speakers may be easily heard, there will be a special installation of sound amplifiers. A time limit for the presentation of any paper will be set and it is hoped that with these improved conditions it will be possible to have greater discussion of papers from the floor.

These expositions are a great educational institution. They offer the coal operator the greatest possible opportunity to see all types of equipment in a minimum of time, under ideal circumstances, and with competent assistance. They give the manufacturer an excellent opportunity to present his equipment at a time when the industry is concentrating its attention upon production problems. The combined Convention and Exposition is the biggest known factor in solving coal production problems.

HOW BETHLEHEM STEEL *Conducts Its* ACCIDENT PREVENTION CAMPAIGN

***A**CCIDENT prevention is reducing human waste—After working places are made safe, it is a matter of vigilance and carefulness, gained effectively by contests — Quarterly and annual awards made — Great decrease in accidents — Benefit is two-fold; economic and in habit of safe practice.*

By J. E. CULLINEY*

The 1928 Bethlehem Mines Corporation Trophy, awarded as a temporary prize to the mine making the best record of the month. The trophy is made entirely of coal with the exception of the clock proper. The names of the winning mines are filled in on the face of the clock

TO ELIMINATE waste wherever it exists is the challenge which is now facing business all along the line from production to consumption. Great strides have been made in manufacturing economies during the last few years, but there still remains much that can be done especially in further reducing the human and economic waste caused by accidents. Accident prevention is a joint responsibility upon employes, as well as employers, which requires active cooperation on the part of both and the enthusiastic interest of every officer and employe.

The Bethlehem Steel Corporation has been doing its utmost to provide safe working conditions, but accident prevention work becomes, after a plant is physically protected, a matter almost entirely of vigilance and carefulness on the part of the individual.

To further the efforts of Bethlehem and its employes to eliminate accidents, a plan was evolved to stimulate greater interest in this work during the year 1928. The plan, which took the form of an Accident Prevention Contest among the various subsidiaries of the corporation, included all Bethlehem employes in the United States and Canada.

Quarterly and Annual Awards

The plan provided for two forms of award, a quarterly award and an annual award for the greatest percentage of reduction obtained in the accident severity rate, that is to say, the number of days lost for every thousand hours worked. For the quarterly award, the group making the greatest percentage of reduction in accident severity rate during each three months' period in the year 1928 was to be awarded the grand prize of $1,000 in gold. To the groups making the second and third best showing, prizes amounting to $500 and $250, respectively, were to be awarded. For the annual award, the group showing the greatest percentage of reduction in accident severity rate during the full year was to be awarded a trophy to be held in its possession permanently.

The cash awards were to be disbursed by the winning groups in such a manner as would best recognize individual effort of employes in accident prevention work. This was to be determined jointly by the management and representatives of the employes of the winning groups.

Method of Determining Winners of Contest

The winners under this contest were to be the groups showing the greatest percentage of improvement in their severity rate for the period in question over the lower yearly severity rate for the two previous years (1926-1927). For example: Assume that the severity rate for a group was 3.50 for 1926 and 3.00 for 1927, the rate for 1927 being the lower yearly record for the 2-year period, would be taken as the base for arriving at the percentage of improvement attained. Thus, by taking the record yearly severity rate of 3.00 and assuming the rate during a contest period of 3 months is reduced to 1.25, the result would be figured as follows:

Record yearly severity rate to be used	3.00
Severity rate for contest period of three months	1.25
Difference	1.75

Percent of improvement $\frac{1.75}{3.00} = 58.33$.

The annual award was to be determined on a similar basis, taking the percentage reduction for the whole year 1928 instead of for one quarter.

Promotion of Contest Within the Groups

The quarterly contest for cash awards and the yearly contest embraced all Bethlehem employes, divided into 11 groups, all of which were encouraged to carry out a vigorous day-to-day accident campaign.

The following methods were suggested:
(1) Inter-Departmental contests.
(2) Organization of teams.

It was proposed that inter-departmental contests should be conducted on a monthly basis between the various departments or divisions within the group. Such awards were to be made as would insure the greatest cooperation on the part of all employes. For instance:

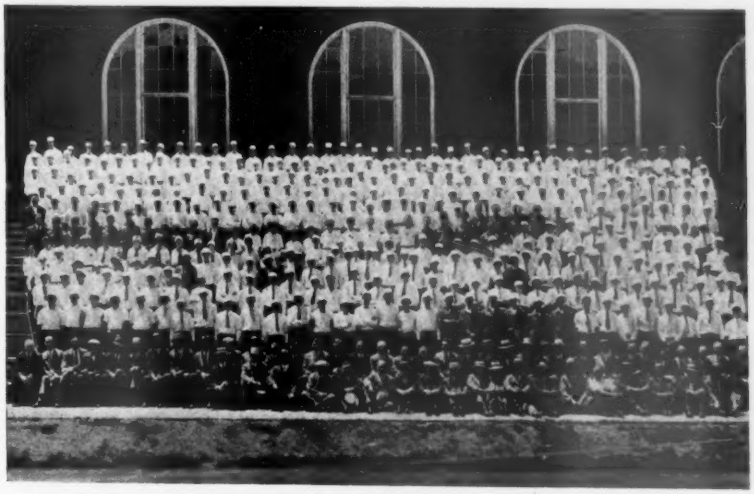
(1) An award for the department or division showing the greatest reduction in the current monthly accident severity rate over some previous

* Safety Engineer, Bethlehem Steel Company.

period to be determined by each group.

(2) Awards to those departments or divisions that were successful in having no lost time accidents during the calendar month.

For the organization of teams, captains selected by the management of each group and drawn from the heads of various departments or divisions selected in their turn a team or teams, the number and size depending on the size of the unit, to meet periodically and discuss ways and means of furthering the accident prevention campaign. Each member of the team had specific duties to perform in addition to general safety work.



Teams which took part in a preliminary first aid meet, representing the Johnstown district. The participants consisted not only of employes of the Bethlehem Steel Company, but also of Boy Scout teams from the City of Johnstown and boy and girl teams from the mining communities

Results of Contest

The campaign thus conducted under the Gold Award Accident Prevention Contest effected a remarkable improvement in reducing accident severity, the primary purpose of the contest. How successful it has been can best be judged from the fact that in addition to reducing accident severity, the contest also brought about a reduction in the number of accidents and in the number of fatalities. Moreover, this improvement was made notwithstanding a rate of operation maintained throughout the year higher than any year since 1917.

The winning group gained the annual trophy by reducing the accident severity by 52.4 percent during the year. The Mines Group, with a force of approximately 7,500 men, finished in fifth place having bettered their previous accident severity record by 40 percent.

The percentage improvement in severity (the time lost due to accidents), in frequency (the number of accidents) and fatality rates (the number of fatal accidents), for the year 1928 is as follows:

	Percent Improvement
Severity	24.2
Frequency	28.4
Fatalities	34.2

These three taken together are the measures by which safety of operations and effectiveness of accident prevention work may be judged.

In order to help make this fine record it was necessary, at the beginning of last year, to organize in all groups engaged in the contest safety teams in addition to Bethlehem's regular safety committee organization for the purpose of enlisting a greater number of the employes in active accident prevention work. These organizations were changed every three months, and by so doing at least half or approximately 35,000 employes were actively serving on safety teams at some time during the year 1928.

This improvement, however, means a great deal more than merely establishing a proud record. Its greatest significance lies in two directions: First, in the economic saving to the company, to the employe, to his family, and to the community; second, in the habit of safe practice which such a record demands on the part of the individual.

The reduction in lost time accidents during 1928 represents not only a real conservation of life and health, but also a large saving in wages to Bethlehem employes. Add to that the reduction in cost of compensation and treatment of injured employes and the elimination of other costly wastes due to accidents and you get some idea of its economic importance. The reduction in days lost due to accidents was about 166,000 days. It is estimated therefore that the 1928 results will mean an ultimate saving in wages of more than three-quarter of a million dollars to employes.

Gold Awards to Be Continued in 1929

The results of the 1928 Accident Prevention Contest have been so satisfactory that it has been arranged to continue the contest in 1929 on the same basis and for similar prizes as in 1928.

The prize winners will be the groups showing the greatest percentage of improvement in their severity rate over the lower yearly severity rate of the two previous years (1927-1928).

Three cash prizes of $1,000, $500, and $250, will be awarded each quarter to those groups winning first, second and third place respectively. A trophy will be awarded to the group making the best record for the year.

Bethlehem Ten Year Record of Safety Improvement

During the last 10 years Bethlehem has made steady improvement in safety of operations amounting in the aggregate to a reduction of 63 percent. A comparison by years of the progress made in the reduction of accidents over the last 10 years shows that, using the 1929 record as the base, a slight improvement in the number of accidents occurred in 1920 and 1921. In 1922, perhaps due partly to a considerable increase in operations over the previous year, the number of accidents increased. From 1923 to 1928, however, there was a steady reduction in accidents, while in 1928 the percentage improvement was greater than in the two previous years taken together. During this same 10-year period there has been a corresponding decrease in severity or lost time due to accidents as well as in fatalities.

"The Heat Treatment of Steel" is the subject of the latest addition to the library of educational motion picture films produced by the Bureau of Mines for the visualization of the mineral industries of the country.

Copies of this film are now available for exhibition. Applications for the use of the film should be addressed to the Pittsburgh Experiment Station of the United States Bureau of Mines, Pittsburgh Pa. No charge is made for the use of the film.

COAL-MINE FATALITY RATE SHOWS SLIGHT INCREASE IN 1928

Accidents in coal mines in the United States during the calendar year 1928 were responsible for a total of 2,171 deaths, according to figures compiled by the United States Bureau of Mines. Of this number 1,724 fatal accidents occurred in bituminous mines and 447 in anthracite mines. The production of coal for 1928 is estimated at 492,755,000 tons of bituminous and 76,734,000 tons of anthracite, thus showing a fatality rate per million tons of coal mined, of 3.50 for bituminous and 5.83 for anthracite, with a total of 3.81 for the entire industry. All 1928 figures are subject to slight revision, due to delayed reports, but the present rates are indicative of the cost in human life of the coal produced last year. These figures for 1928, when compared with those for 1927, indicate a slight increase in the death rate for bituminous mines and for the coal industry as a whole, notwithstanding a reduction in the death rate for anthracite mines.

Accidents occurring at all coal mines during the month of January, 1929, caused the loss of 177 lives, according to information received from state mine inspectors by the Bureau of Mines. Of these fatalities, 139 occurred in bituminous mines in various states and the remaining 38 in the anthracite mines of Pennsylvania. The output of bituminous coal during the month was 51,456,000 tons, while that for anthracite was 7,337,000 tons. Based on these figures the fatality rate for bituminous coal was 2.70 per million tons of coal produced; the anthracite rate was 5.18, and the total was 3.01. For the same month in 1928 there were shown a bituminous death rate of 3.17, based on 140 deaths, and 44,208,000 tons production; an anthracite rate of 4.92, based on 28 fatalities, and 5,690,000 tons; and a rate for both bituminous and anthracite of 3.37, based on 168 fatalities and a total production of 49,898,000 tons. Compared with the month of December, 1928, the death rates for January were considerably lower both for bituminous and anthracite mines.

One major disaster—that is, a disaster in which five or more lives are lost —occurred during the month of January, 1929. This was an explosion at Kingston, W. Va., on January 26, which caused the death of 14 men. Only one such disaster occurred in January a year ago, when 21 men lost their lives in an explosion at West Frankfort, Ill., on January 9. Fatality rates per million tons, based exclusively on these major disasters, were 0.238 and 0.421, respectively.

A comparison of the principal causes of accidents in January, 1929, with those for the same month last year shows lower accident rates per million tons for falls of roof and coal, and gas or dust explosions; while the rates for electricity were practically the same; and a slight increase is shown for both haulage and explosives. The fatality rates for January, 1929, as compared with the year 1928 show lower rates for all the principal causes of accidents with the exception of explosives which was slightly higher.

U. S. COPPER PRODUCTION SHOULD CONTINUE AS CHIEF FACTOR IN WORLD OUTPUT

This country's production of copper will probably continue to be the chief item of world production of that metal for many years, according to an historical review of the economics of this commodity made by the Common Metals Division of the Bureau of Mines. The country's proportion in the world total of copper production, may, however, be expected to decrease slowly for a time, while the South American, the African, and the Canadian proportion will probably continue to increase. Great reserves of proven ore exist in the United States to support its production of the near future, and there probably are also also enormous quantities of very low-grade copper-bearing rocks that will become of economic importance as the relatively high-grade ores of the world approach exhaustion some decades hence.

Mexico and Canada during the past 50 years have likewise developed steadily as dependable producers, the former having yielded a somewhat larger tonnage in the past, while the latter has made such important copper discoveries of late that its rank as a producer may be expected to improve substantially in the near future.

North America, as a whole, produced nearly 66 percent of the world production for the first quarter of the present century and 61 percent in 1926-27.

The South American production may be regarded as well established and of stability comparable to that of North America. The production of North and South America together in 1926-27 was nearly 80 percent of world production.

In Asia, Japan steadily maintained a production of 3,000 to 5,000 tons a year during the period 1800-1880, but in 1883 commenced to expand production until it now averages about 70,000 tons a year or about the same amount as Canada and Mexico. The production of Japan serves to meet its own requirements, but is not likely to affect the world situation otherwise.

Australasia began to produce copper just before the middle of the last century and since has produced continuously, although production has fluctuated greatly in amount. It reached about 50,000 tons a year during the period 1910-1913 but has since fallen to about 12,000 tons. Further potential resources are known in Australasia, and their mining may become profitable again when higher prices for the metal prevail.

Africa is the great new source of copper production, especially the Katanga deposits in Belgian Congo. Production started in 1911, has steadily increased to about 100,000 tons, and is expected to increase, as the known reserves of ore are large and of relatively high grade.

European production of copper has steadily increased from 12,400 tons a year in 1800, which amounted to 68 percent of the world production at that time, to over ten times that amount (about 135,000 tons), which is only about 8 percent of world production in 1926-27.

England's production, formerly 40 percent of the world total and amounting in a decade to as much as the present annual production of Mexico, Canada, or Japan, has virtually ceased.

Russian production showed little change throughout the nineteenth century, then increased substantially until the beginning of the Great War, when it relapsed to its former magnitude.

The most important production of Europe has come from Spain and Portugal, whose deposits are similar in character and of the same mineralized zone. This production was insignificant at the beginning of the nineteenth century, but began to expand 50 years later. Since 1880 it has averaged about 50,000 tons a year.

Germany's production steadily increased from the beginning of the nineteenth century to an annual production of more than 20,000 tons. This output was considerably exceeded during the World War and in 1926-27 had risen to about 30,000 tons.

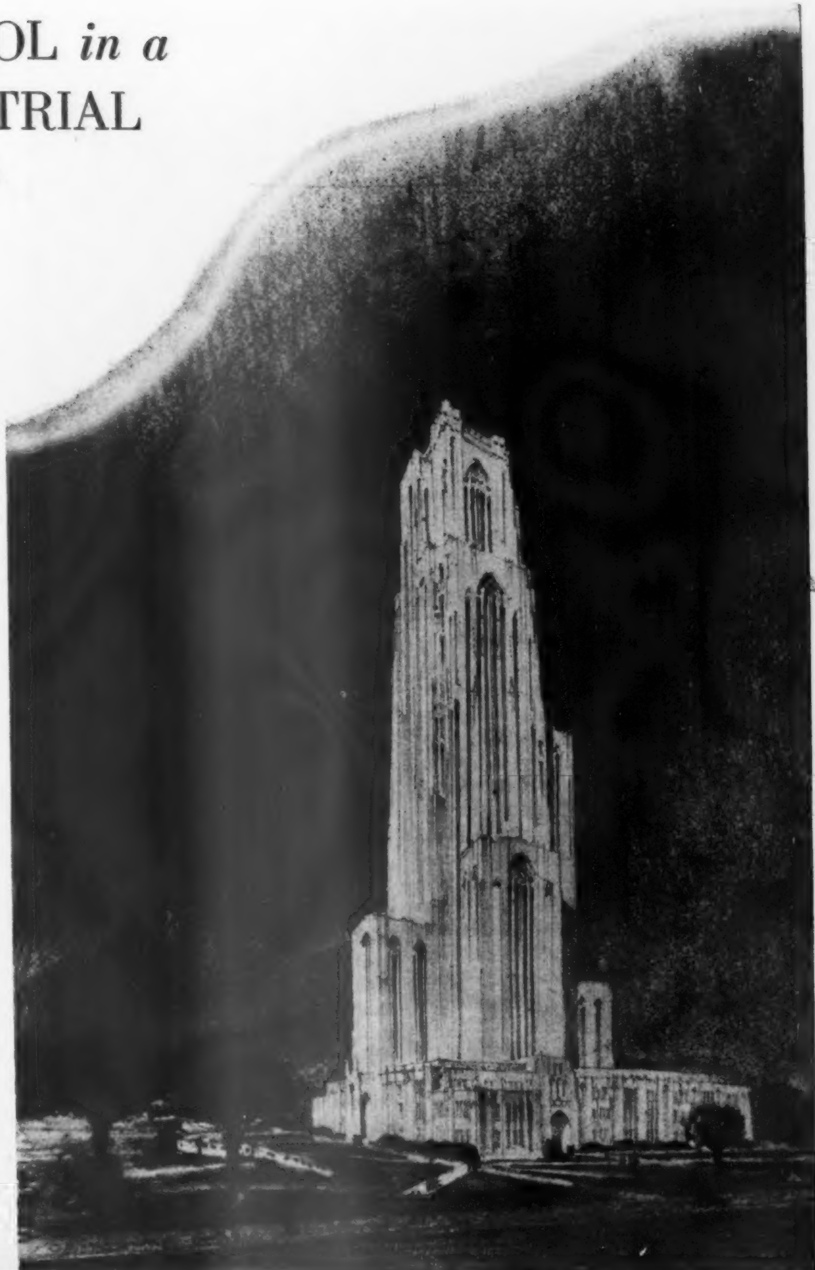
The production of an important common metal, such as copper, is by no means casual or sporadic, the Bureau of Mines observes, but is closely related to such factors as the existence of metallogenic provinces, the distribution and movements of populations, and the nationality of the financial control of industries. World production may be regarded as the integration of many such factors.

Data regarding the output of copper in all principal producing countries from the beginning of the nineteenth century to the present time, are contained in Economic Paper 1, copies of which may be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D. C.

A MINING SCHOOL *in a* GREAT INDUSTRIAL CENTER*

By E. A. HOLBROOK †

School of Mines at University of Pittsburgh has fortunate location in great coal center—Work of the school and opportunity offered students presented — Cooperative opportunity with industry an advantage



LOCATED in the greatest industrial center of the world, the School of Mines at the University of Pittsburgh offers unusual opportunities for the student to have daily contact with mines, furnaces, and the many plants based on the mineral industry.

The school was established by an act of the state legislature approved July 5, 1895. Under the terms of the act a sum was specifically appropriated to the trustees of the University of Pittsburgh "for the purpose of establishing * * * a School of Mines, the object of which shall be to thoroughly educate young men in the principles and art of mining engineering included within the oil, gas, and bituminous coal fields of this commonwealth."

At the present time there are given five separate four-year courses leading to the degree of bachelor of science in the particular fields of mining engineering (both coal and general mining), metallurgy, petroleum engineering, petroleum geology, and petroleum refining. The course in petroleum refining is unique in that a parallel course probably is not being offered elsewhere. The course is cooperating closely with the great oil refining industries, and its graduates are in real demand. The petroleum engineering course is of international character as there are enrolled at present students from at least six different countries. The metallurgy department maintains close contact with many of the industrial laboratories of

* Third, in a series of 12 articles upon Mining Schools of Distinction.
† Dean, School of Mines, University of Pittsburgh.

Above — "The Cathedral of Learning," the new building now under construction which will house the offices and classrooms of the School of Mines

Left — A corner of the Mining and Metallurgical Laboratories at the University of Pittsburgh

Camp Hamilton, in the Allegheny Mountains, near Windber, Pa., owned by the University of Pittsburgh

the district. In mining engineering, the school offers not only well equipped laboratories, but easy access to many coal, limestone and other mines in the surrounding districts. Special graduate work is offered for students who wish to carry on research or other graduate work under the favorable conditions made possible by the situation of the school.

Because of its situation, the school is able to offer to the undergraduate student, cooperative work with the industries. Under this cooperative plan, the school places the student at work in his chosen industry for at least two semesters or summer terms during his college course. This work is supervised by the school, but the student receives regular pay from the industry. Thus there is real opportunity to combine theory and practice while the student is in college.

A feature of the school is Camp Hamilton. This is a permanent camp owned by the University and situated in the Allegheny Mountains near Windber, Pa. At the end of their junior year, the students go into camp for two weeks of hydraulics laboratory work. This work is followed by 10 weeks of outdoor surveying and geological field practice.

During the college year frequent visits to the industries are part of the weekly program. This work is a vital supplement to the regular class and laboratory periods on the campus.

The coming year will see the completion of a part of the great "Cathedral of Learning" which will be occupied by the class rooms, offices, and laboratories of the university. Certain of the instruction, however, will still be carried on in the present buildings.

The whole group of university buildings situated in the Oakland section of Pittsburgh are adjacent to the Carnegie Museum and Library, the United States Bureau of Mines, the Mellon Institute of Industrial Research, and to metallurgical and other research departments maintained by private corporations.

This School of Mines is one of the few able to offer evening courses to men engaged in the industries. At the present time courses are being offered at night in the department of oil and gas. This work will be extended to other departments as soon as the completion of the Cathedral of Learning makes additional space available.

Many of the students in the school are working part or full time in the industries and are supporting themselves either wholly or in part while they attend college. Thus a number of men are taking courses at college in the mornings and are working afternoons or evenings at the many metallurgical plants here. Although it often takes such a student more than four years to complete his college course, yet his rise in the industry after graduation is more rapid than the ordinary college student because of his practical knowledge of the industry.

Altogether, there are three outstanding features of the University of Pittsburgh School of Mines:

1. Contact with the industries during the students college course.
2. Opportunity to the student for cooperative work.
3. The educational and social contacts offered through the school being a part of a great university.

FIRST-AID TRAINING BEING PUSHED IN MINING DISTRICTS

The first-aid training work of the United States Bureau of Mines is proceeding vigorously in a number of important mining, petroleum, and quarrying fields. The outstanding feature of this work at present is the 100 percent cooperative first-aid training campaigns being conducted. The aim of these campaigns is to accomplish the training in first-aid measures of the entire personnel employed by a mining company. Under this system, the first-aid instructors of the Bureau of Mines give the training to a number of key men at a large mining operation, and in turn the key men, under the direct supervision of the Bureau's instructors, train all other employes. At the conclusion of the instruction, each miner must successfully pass an examination conducted by a Bureau of Mines instructor before being given a certificate of proficiency in first-aid measures. Approximately 4,000 miners are trained monthly under this plan in addition to large numbers of others who are given the training by other means.

At present, the crews of the following-named mine-rescue cars are conducting 100 percent cooperative first-aid training campaigns:

Car No. 1 is operating out of Morgantown and Fairmont, in the northern West Virginia coal field, and will be engaged in that field for the next several months.

Car No. 2 will be engaged in training work in the southern Colorado and northern New Mexico coal fields until about July 1.

Car No. 3 is working in the Pittsburgh coal district of western Pennsylvania.

Car No. 4, with headquarters at West Frankfort, Ill., will be engaged in the southern Illinois coal field until about July 1.

Car No. 5 will be at or around Kenvir, in the southeastern Kentucky coal field, for the next two or three months.

Car No. 6, with Henryetta, Okla., as a base of operations, is training employes of the Oklahoma coal fields. Some members of the crew of this car are training employes of oil companies operating in the west Texas fields.

Car No. 7 will be at Welch, West Virginia, until April or May while training employees of the coal mines of southern West Virginia.

Car No. 9 will be engaged in the training of employes of oil companies operating in southern Wyoming until approximately May 1.

Car No. 10 has for some weeks been at Whiting, Ind., and will remain there for the next 60 days giving the first-aid training in the oil-refining industry.

Individual employes of the Bureau of Mines are also conducting 100 percent cooperative first-aid training campaigns in the Washington coal mining field, in the eastern Tennessee coal district, in the western Kentucky coal field and in the Florida rock phosphate mining field.

The first-aid training activities of the Bureau of Mines in the states of Illinois and West Virginia are being conducted under cooperative agreements with the state mine inspection departments.

Grand Valley of Colorado River from entrance to the 1927 drift at the Experimental Mine

THE BUREAU OF MINES OIL-SHALE EXPERIMENTAL PLANT*

By MARTIN J. GAVIN †

Shale, principally mined underground, yields 30.5 gallons per ton—Drilling and blasting procedure described—Types of retorts discussed — Commercial value of experimental plant great—Its future dependent upon appropriation

THE experimental oil-shale plant of the Bureau of Mines is now in the second year of operation. The experimental equipment includes the mine and retorting plant, situated near Rifle, Colo., and the experimental refinery and research laboratory at the University of Colorado, Boulder, Colo. The retorting plant was constructed and operated until July 1, 1927, under two congressional appropriations: the first, of $90,000, was made available on March 4, 1925, and the second, of $89,000, on July 1, 1926. The experimental refinery was constructed with funds provided through the cooperation of the State of Colorado, and its staff is furnished by the Bureau. The research laboratory has been maintained and staffed jointly by the Bureau and the state since 1920.

Construction of the plant was started in October, 1925, and the first shale was retorted on September 17, 1926. The plant and experimental refinery were closed on July 1, 1927, as no funds were provided by Congress for operation during the fiscal year 1927-1928. The regular appropriation measure for the Bureau of Mines carried an item of $5,000 to place the plant in condition for at least temporary abandonment and to maintain a watchman on the premises. In July and August, 1927, the plant was partly dismantled and much of the equipment was stored in one of the buildings. In January, 1928, Congress appropriated $45,000 to put the plant in operating status and to make the alterations of equipment which had been found necessary for efficient operation by the pioneer work of 1926-27. The regular Bureau appropriation for the year 1928-29 contained an item of $75,000 to operate the plant and refinery during the current year. This item was $15,000 less than the amount estimated as necessary to continue operations until June 30, 1929, consequently the plant will again be shut down about April 15, 1929. Under the new appropriations a force began reconditioning the plant in February, 1928; fires were started in the Pumpherston retort in May, and retorting of oil shale was resumed late in June. Active work at the experimental refinery was undertaken again in March 1928.

The experimental oil-shale mine is situated on Naval Oil Shale Reserve No. 1, at an elevation of 8,000 ft., and is approximately 2½ miles northwest of Rulison station. Rulison is on the main line of the Denver & Rio Grande Western Railroad, 9 miles west of the town of Rifle. The experimental plant, at an elevation of 5,600 ft., is approximately 1 mile southeast of the mine, and is on Naval Oil Shale Reserve No. 3. The mine and plant are connected by a 3-mile trail and a 5,800-ft. aerial tramway.

MINE

During 1926-27 the oil-shale mine was worked mostly as a quarry; shale was obtained from the section logged in the accompanying table (page 196). This section is the richest horizon of the Green River shales; as shown in the table, the oil shale ranges in richness from only a few gallons to 78 gallons per ton of shale. A continuous vertical section of 69 ft. yields oil at the rate of

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Airplane view of the mine and plant site—(1) mine site; (2) tramway tower No. 1; (3) tramway tower No. 2; (4) plant site in canyon floor just below the ridge

30.5 gallons per ton. In 1927 a short drift was driven in the richest zone of the section to obtain coking shale without extending the quarry face. In 1928 two drifts were started just above the base of the section shown in the table (page 196) and a system of raises and stopes was developed. Most of the shale for the plant is now being obtained from the underground workings, but from time to time shale is taken from the quarry.

Mine buildings and machinery include the bunk house, mess house, machinery buildings and shop, gasoline-engine-driven compressor, forge, drill sharpener, tramway machinery and bins. The mine camp, being about 2,400 ft. above the retorting plants, has its own cook, and all supplies, including water, are sent up by the aerial tramway.

Light-weight air-drills with cross-point bits are used in the mine and quarry—jack-hammers for down holes and drifting (the machine mounted for drifting) and a stoper for raising. Drilling presents no unusual problems. Air-operated augers have been tried, but were ineffective. Thus far the work has indicated that the drill should be a high-speed machine which strikes a relatively light blow and has ample air capacity for blowing the hole free of cuttings. In most of the shale the cuttings are relatively coarse; little fine dust is formed, but there is enough dust, particularly from the leaner shales, to make wet-drilling necessary in underground work.

Thirty-five percent gelatin-dynamite has given the most satisfactory results in quarry shooting, but only permissible explosives are used underground. Two grades of permissibles have given entirely satisfactory results. Shale from either mine or quarry is trammed in cars to the loading terminal of the aerial tramway and dumped into loading bins.

Tramway

The tramway installed in 1926 was a single-bucket reversible type, driven by a gasoline engine at the upper terminal. The tram structures were designed for ready conversion of the system into a two-bucket reversible gravity type, and the change was made in the spring of 1928. The slope length of the tramway is 5,800 ft., and the carriers descend 2,175 ft. in this distance. Track rope is 1-in. plow steel and traction rope is 0.5-in. There are only two towers on the tramway, except for the terminal structures. The span between the two towers is 4,200 ft. With the single-bucket tram the maximum capacity was approximately 2½ tons per hour—five trips. The present reversible gravity system has almost doubled this capacity and has eliminated the frequent delays caused by the breaking of power and the idling shafts at the upper terminal of the single-bucket system. The engine at the upper terminal is still used to haul up return loads of mine supplies and occasionally to spot buckets at the terminals. Usually two or three buckets of supplies are taken daily to the mine; single loads weighing up to 1,100 pounds have been hauled over this cableway. When the tram was converted to a two-bucket system, the storage capacity for shale at the loading terminal was increased from 7 to 14 tons and, at the two-compartment discharge bin, from 80 to 120 tons.

Experimental Plant

Below the lower-terminal bin is the single-roll shale crusher which has a capacity of 7 tons per hour and is belt-driven by a gasoline engine. The crusher has a feed opening, 18 by 16 in., and has given entirely satisfactory results. In the earlier work the crushed shale dropped either into a storage bin of 20-ton capacity or directly into a steel chute which led to the retorts. When the plant was reconditioned in 1928, the old crushed-shale bin was replaced by a larger one situated lower down the hillside and nearer the retorts. Shale now falls from the crusher to a chute which carries it to the bin. From a point immediately below the bin a steel trestle leads to the top of the Pumpherston retort. Shale is loaded from the bin discharge directly into an end-dumping ore car of 1-ton capacity, is weighed, and is trammed to the top of the retort. A short steel chute leads from the Pumpherston retort to the charging door of the N-T-U retort; thus either retort may be charged from the top of the Pumpherston. The maximum thickness of the individual pieces of shale charged to the retorts is approximately 2 in.

The retorts at the experimental plant are briefly described in the following paragraphs. The other equipment consists of the boiler plant with two 35-hp. boilers of the oil-field type, now fired most of the time with crude shale oil made at the plant; a 40-hp. gas producer fired with petroleum coke to supply auxiliary fuel for the Pumpherston retort; a 5-kilowatt turbo-generator set which supplies electricity for plant and camp lighting, laboratory apparatus, and for the motor that drives the pump on the producer-water circulating system; a storeroom and machine shop with facilities for making minor repairs; steam-heated laboratory and office building; and water-supply system. Water for the plant is pumped by gasoline-engine-driven pump through a 2-in. line from a well on the bank of the Colorado River, 1¼ miles southeast of and 600 ft. lower than the plant, to storage tanks above the retorts. An improvement in 1928 was the installation of a condenser for the turbines and of a water-cooling and recirculating equipment for the gas producer. These have greatly decreased the water demand of the plant and the recovery of condensed steam has materially improved the quality of the boiler feed-water. The camp buildings at the plant, other than those mentioned above, include mess and bunk houses and smaller dwellings for some of the plant force.

RETORTS

The retorts are the shale-oil producing units of the plant. The first retort erected and operated is a Pumpherston or Bryson retort; the second, of entirely different type, is a Dundas-Howes, known better as the N-T-U.

The fundamental basis for the selection of these retorts for the experimental work was the result of more than five years of laboratory study in the Cooperative Oil-Shale Laboratory at Boulder, Colo., supplemented by a study of the literature and a field investigation of retorts proposed for use, and in use, in this and other countries. Both retorts installed are mechanically simple, rugged in construction, operate on principles established by laboratory study to be fundamentally sound, and are easily adapted to experimental work. Both types had been operated long enough for their limitations and methods of control to be fairly well established and for the engineering problems of construction and operation to be reasonably well worked out.

Pumpherston Retort

The Pumpherston retort is a continuously operating vertical, externally heated type, rated in Scotland as having a capacity of 4½ to 5 tons per day. This rating is for typical Scottish shale, with the retort working to produce the most profitable yields of oil and ammonia. The retort at the experimental plant, except in minor details, is an exact duplicate of the experimental retort in daily use at the Pumpherston Works of Scottish Oils, Ltd., of Scotland. It is a full-sized commercial unit of the present most fully developed and best type of Scottish retort. The Pumpherston retort is now and, for more than 25 years, has been used successfully in the Scottish oil-shale industry. All metal parts and special bricks for the retort at the experimental plant were purchased in Scotland by the writer and the retort was erected under the supervision of a construction expert furnished by a Scottish retort manufacturing company.

The Pumpherston retort has been described in detail in publications of the Bureau of Mines,* and it is desirable here only to call attention to the design of the brick section of the retort which permits the retort proper to expand and contract independently of the side walls, and to the use of steam in the retorting process. Steam, which may be exhaust steam from the power plant, is admitted to the spent shale hopper in direct contact with the shale and serves the following purposes:

(1) Steam cools the spent shale and is itself superheated; rising through the shale charge, it gives its heat to the distilling charge.

(2) Steam distributes the heat from the spent shale and from the side walls uniformly through the charge.

(3) It reacts with the fixed carbon of the spent shale, producing a mixture of hydrogen, carbon dioxide, and carbon monoxide which eventually becomes part of the fuel supply for the retort.

(4) It prevents undue decomposition of the oil by increasing the velocity of the oil vapors through the retort.

(5) It increases the production of ammonia from the nitrogen of the shale.

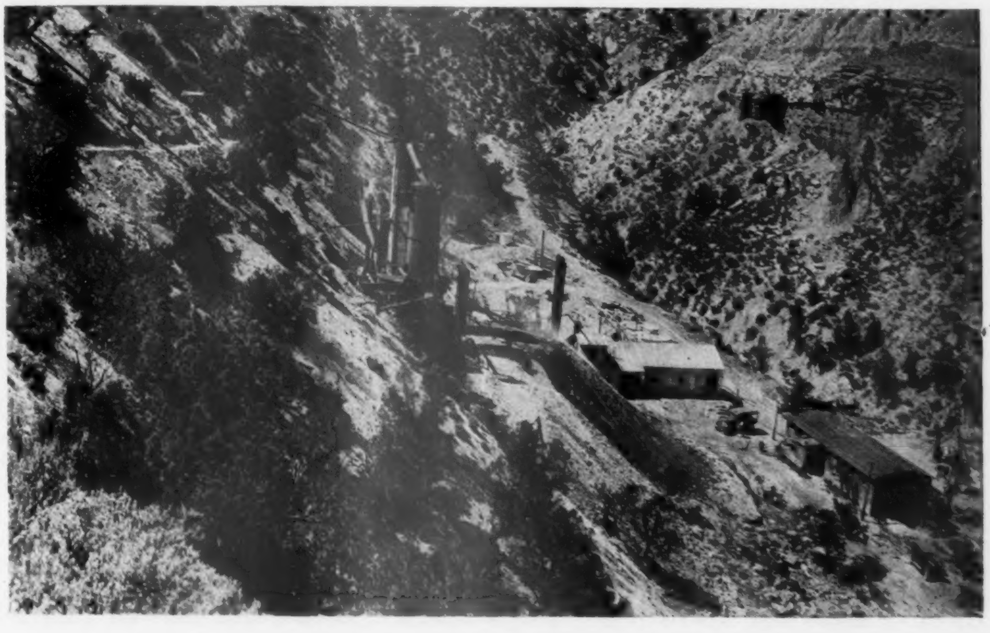
So much misinformation has been current in this country regarding the Pumpherston retort that the writer again emphasizes the fact that it operates continuously; that the feed to, through, and from the retort is by gravity, the rate of feed being regulated by a simple easily controlled mechanical device, the only moving part of the retort; and that steam, internally supplied through the bottom hopper, raises the thermal efficiency of the retort to a relatively high value, although full advantage has not been taken of all opportunities of conserving heat.

At the experimental plant, vapors and gases from the retort pass in series through a three-stage atmospheric condenser—a water-cooled condenser of conventional design; a water scrubber for removal of dust and ammonia remaining in the gases; and an exhauster which draws the vapors and gases from the retort, through the condensing system (the suction on the retort offtake is 0.10 to 0.20 in. of water), forces the gas through an oil scrubber to recover light gasoline, and finally delivers it to the return-gas burner. The retort is heated by the return gases, supplemented when necessary by producer-gas made from petroleum coke.

The oil and water condensing in the system are trapped off at four points; a trap is provided for each header of the atmospheric condenser and for the outlet header of the water-cooled condenser. These traps are of original design and serve also as water separators. From the traps the oil flows to 25-barrel run tanks and thence to a 250-barrel storage tank.

N-T-U Retort

The N-T-U retort, in contrast to the Pumpherston, is of the internally heated, down-draft, intermittent type. It is essentially a vertical, fire-brick lined cylindrical shell. The top is fitted with a charging door and controllable openings for combustion-air and return gas. The bottom, which carries the grates, is mounted on wheels that run on the lower inside flanges of horizontal H-beams of the supporting structure. The bottom is moved from under the shell and back into place by a long screw operated through a reduction gear by a steam engine. On the front of the bottom a short vapor offtake pipe slides into a fitting on the main vapor line as the bot-



General view of the experimental plant.

* Gavin, M. J., Oil Shale: Bureau of Mines Bull. 210, p. 69 (1924).

tom moves into place beneath the retort. The joint is made tight by a clay-luting. The N-T-U retort is of American design and has been used in California for several years to recover oil from diatomaceous shales. The retort at the experimental plant is about half the size of those used in California, and receives charges of 27 to 30 tons of typical Green River oil shale.

Entrance to 1927 drift in "mahogany" zone of oil shales.

In operation, the bottom is run into place beneath the retort and luted tight with a mixture of clay and shale oil; the retort is charged to the spring line of the dome and a wood fire is started on top of the charge. An exhaust fan meanwhile draws combustion and distillation products downward through the charge and through the tubular condenser, then forces them through a cyclone separator and out through a waste-gas pipe which runs on a slope of 35° to the crest of the hill back of the plant. As soon as the shale charge is satisfactorily ignited, the retort charging door is closed and luted. Part of the combustion and distillation gases are then returned to the top of the retort, while a regulated quantity of air is admitted at the top through ports around the return-gas nozzles.

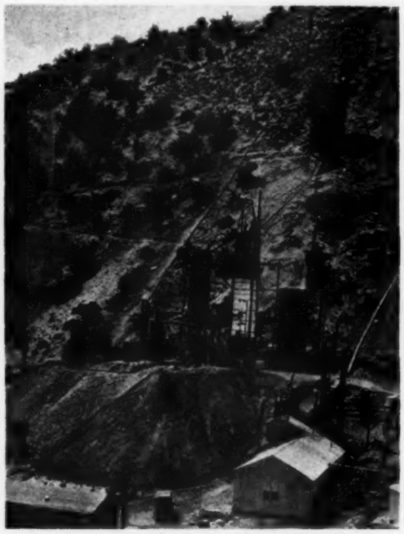
Distillation may be conducted either by maintaining gaseous combustion in the dome of the retort and allowing the hot products of combustion to pass down through the distilling charge, or by so regulating return gas and air that a combustion zone travels down through the charge, burning out the fixed carbon of the spent shale, while a distillation zone precedes the combustion zone. Four thermocouples in the bottom of the retort, just below the grates, indicate a temperature of approximately 140° F. throughout the greater part of the run. As the combustion zone reaches the bottom of the retort, the temperatures of one or two of these couples rise more or less rapidly, depending on the proportions and volumes of air and return gas being used. When any one of the thermocouples indicates a temperature of approximately 1,000° F., the air ports at the top of the retort are closed, thus stopping combustion, and the return gas valves are opened wide. The return gas is superheated by the hot spent shale in the top of the retort and serves to complete the distillation of the shale just above the grates without subjecting the grates to destructive temperatures. When the lowest indicated temperature reaches 650 to 700° F., the exhaust fan is stopped, the gas offtake valve closed, the retort bottom pulled back, and the spent shale drops from the retort.

Oil is trapped off from the condenser, from the discharge of the exhaust fan, from the cyclone, and from the lower end of the 8-in. waste-gas line. The oil flows to traps and water separators similar to those used with the Pumpherston retort, thence to run tanks, and finally to storage.

Retort Operation

Pumpherston Retort

During the year 1926-27, the Pumpherston retort was operated from September 17, 1926, to July 1, 1927. During this period 1,341 tons of shale were put through the retort and 23,700 gallons of crude shale oil were produced. Tests indicated that an additional 435 gallons of light naphtha might have been obtained by scrubbing the retort gases. (The plant oil-absorption system was not used during this period.) Total oil recovered and recoverable was thus 24,135 gallons; an average yield of 17.9 gallons per ton. Shales ranging in richness from 11 to 43 gallons of oil per ton were retorted. The highest yield from the retort was at the rate of 42.5 gallons per ton retorted. The low average yield was due to (1) the lean shale retorted during the first few months of the work, (2) long periods of operation in which shale was discharged not completely spent, and (3) operation in which the shale was permitted to burn within the retort. The latter procedure is evidently poor practice, but information was desired as to results of operating in this manner. There were two long periods of idleness during November and December, 1926; the first was caused by a broken crusher gear and the second by the dropping of temperatures too low for good operation after a sudden cold snap froze the main water line and caused a water shortage for two days. From December 30, 1926, to March 17, 1927, the retort operated continuously without giving the slightest trouble and handled shale yielding from 11.6 to 42.5 gallons of oil per ton. Some of the material charged was wet and contained much fine, low-grade, and dirty surface shale, but was handled without difficulty. On March 17 the shale hung up in the retort; this was the beginning of trouble caused by coking shale, which continued periodically until June 15. From June 15 to July 1, operation was smooth, and splendid results were obtained.



Retorts, condensers, shale bin, boiler house, laboratory, and spent shale dump.

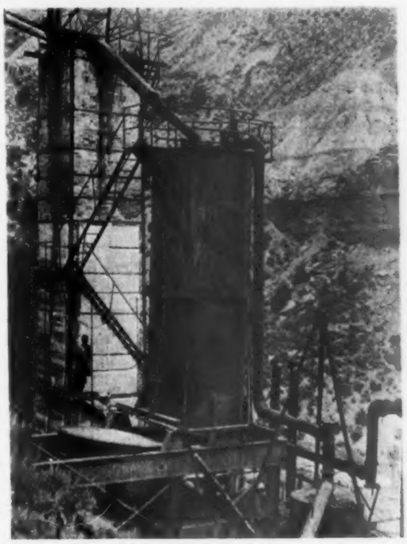
The only trouble experienced with this retort was that caused by coking shale. The difficulty was probably caused by the type of shale used, but evidently it was contributed to by leakage of air and hot combustion products into the retort through a crack in the wall. This crack was not discovered until the retort was inspected after cooling in July, 1927, but was probably caused by an explosion in the combustion flue during the heating period in June, 1926, or by strains transmitted through the structure from the shale chute support on the top of the retort. The coke formed in March, 1927, could not be removed completely until after the retort was cooled in July, and it caused much of the trouble during the intervening period. The good results of the latter part of June were obtained with a relatively rich, noncoking shale.

Certain oil shales, particularly the richer varieties shown in Table 1, have strong coking tendencies and probably will give trouble in any type of retort. The shale which caused the first hang-up was a mixture of coking and noncoking

varieties which yielded 42 gallons per ton. Before this, mixtures of the same varieties yielding up to 35 gallons of oil per ton had been retorted without difficulty, but afterwards such mixtures hung up frequently. Inspection in July showed that accumulated coke had practically reversed the taper of the retort for a few feet. This unquestionably induced packing and permitted coking material to adhere to the coke previously formed.

In the spring of 1928 the adhering coke was thoroughly cleaned from the retort walls and all cracks were repaired. The top part of the combustion flue was enlarged, as the earlier work showed that efficient combustion could not be obtained otherwise when the retort was being operated at high capacities. In 1928, the first shale was charged late in June; until December 16 the total amount of shale retorted was 1,072 tons and 26,810 gallons of oil was produced, an average yield of approximately 25 gallons of oil per ton. The average yield has been increasing steadily from week to week since the resumption of the work. Hang-ups have been infrequent and of short duration and have been caused by accidental admixture of rich coking shale. In general the retort has operated very satisfactorily, has produced valuable experimental data, and reflects the value of the experience of the first years' operation and alterations to the plant. Experimental work is directed to securing information on the influences of variables of retorting and the capacity of the retort under different conditions of retorting and with different shales.

The capacity for certain 30 to 35 gallon shales has been established to be materially higher than the rating of the Scottish operators for 20 to 25 gallon shale, but for high daily oil yields and shale throughput, ammonia production has been neglected. This type of retort has been termed a "dual-purpose" retort (oil and ammonia), but it functions satisfactorily as a producer of gas and oil alone, and probably can be modified advantageously to increase its efficiency as a "single-purpose" retort. High throughput rates are not favorable for the production of ammonia, but the writer is convinced that the production of ammonia from American oil shales is of minor importance as compared with oil production.



The N-T-U retort is the cylindrical structure in the foreground with the bottom pulled out. The Pumpherston is the brick structure directly behind it.

The yield and nature of oil and gas produced by the retort vary with the nature of the shale used and conditions of operation. Oils ranging in specific gravity from 0.875 to .902, and yielding 14 to 28 percent of light naphtha distilling below 200° C. have been produced by this retort. The gas yield has ranged from less than 2,000 to over 5,000 cu. ft. per ton, and its heating value from 275 to 500 B. t. u. per cu. ft.

N-T-U Retort

During the year 1926-27, 29 runs were made with the N-T-U retort; 788 tons of shale were retorted and 13,774 gallons of oil recovered—an average yield of 17.5 gallons per ton. In the present year, up to December 16 31 runs have been made, 880 tons of shale have been charged, and 20,740 gallons of oil recovered—an average yield of 23.6 gallons per ton.

The exhauster used with this retort in the earlier work was not of sufficient capacity to retort the richer shales as rapidly as was thought feasible when air-gas ratios and volumes considered best for good recovery were used. A new exhauster, installed in 1928, has greatly improved retort operation and makes possible the extension of experimental data. The assay values of the shales retorted have ranged from 11.0 to 38.4 gallons per ton, and oil recoveries from 36 to over 95 percent of the assay values of the shale charged. These yields do not include light naphtha and oil recoverable from the retort gases. An evident characteristic of the internally fired retort is the production of an oil fog or mist from which the oil can not be recovered by ordinary scrubbing. Electrostatic precipitation will probably be necessary to recover completely the oil in this fog, although at the experimental plant much oil precipitates in the long waste-gas line installed to carry the fog well away from the plant buildings. The fog constituted a serious nuisance until this waste line was installed.

The N-T-U retort has successfully handled all grades of shales tried, except those of the coking variety. Shortly after the start of a run the strongly coking shales have formed enough coke practically to stop gas circulation. Present work, however, indicates that operating conditions may be established which will permit successful retorting of mixtures containing a reasonable percentage of coking material. The richer noncoking shales usually undergo some change during retorting that causes resistance to gas flow to increase greatly during the run, particularly when the combustion mixture contains a high proportion of return gas. This change is probably the decomposition of carbonates (chiefly calcium and magnesium carbonates) and the subsequent hydration of the resulting oxides by the moisture in the return gas.

Actual retort operation and discharging of shale is ordinarily quite simple. During runs in cold weather, oil occasionally congeals in the vapor and waste gas lines and thus stops gas flow; this is to be expected, however, and must be provided for in all installations handling the high-melting point oils produced from the Green River shales. It is sometimes difficult to determine just when the charge is completely retorted. This accounts, first, for some of the low oil recoveries when the charges were dumped before all the oil had been distilled; and second, for some of the long retorting periods when the charge was dumped evidently some time after all the oil had been produced. As experience is gained, this problem is being solved.

Retorting periods have ranged from 18¾ to 48 hours. The variables introduced have been the different grades and mixtures of shales charged; different ratios and volumes of air and return gas used, and the use of steam during part or the entire period of retorting. Combustion mixtures running from straight air to 40 percent air and 60 percent return gas have been experimented with. In 1926-27 yields and retort performance were frequently erratic, but in the present year the improved control and better operating technique have given much more consistent results. In particular, consistently high recoveries have been obtained.

The oils produced by the N-T-U retort are always heavier and contain a smaller amount of the more volatile fractions than those produced by the Pumpherston retort; their specific gravities have ranged from 0.915 to .938. and the amount distilling to 200° C. has been as low as 3 and as high as 10 percent. Thus far the influences of retorting variables on the nature and amount of oil pro-

ASSAY LOG OF OIL-SHALE SECTION EXPERIMENTAL MINE, GARFIELD COUNTY, COLO.
(Samples are cuttings from vertical holes, drilled down with air-operated jack hammer.)

Distance Above Base of "Sandstone Marker"	Section	Yield	Sp. Gr. of Oil	Coking * Character	Remarks
Feet	Feet	Gallons per ton			
19.8	2.0	23.3	0.905	0	
17.8	2.0	17.6	0.902	0	
15.8	1.3	15.6	0.907	0	
14.5	2.0	24.0	0.908	0	Contains two oil-bearing sandstone members; upper 1 inch thick; lower 3 to 6 inches thick, yielding 19.6 gallons oil per ton.
12.5	2.0	27.0	0.904	0	
10.5	1.0	35.2	0.905	1—	
9.5	2.0	37.2	0.896	1	
7.5	2.0	25.5	0.898	0	
5.5	1.5	19.2	0.908	0	
4.0	2.0	20.9	0.905	0	
2.0	1.5	20.1	0.902	0	
"Sandstone marker"	0.5	5.6	.....	0	
Below marker					
1.5	1.5	10.9	0.900	0	
3.5	2.0	16.2	0.910	0	
4.7	1.2	44.8	0.900	2	
6.7	2.0	24.6	0.897	0	Light and dark gray.
8.8	1.6	25.7	0.898	1—	Light and dark gray, streaks of limestone cells.
9.5	1.2	27.9	0.893	1—	Black and dark gray.
11.3	1.8	37.1	0.890	0	Black and dark gray.
12.3	1.0	67.5	0.882	8	Black, waxy, contains 1 to 2-in. compressed waxy seam.
13.3	1.0	48.6	0.883	6	Black, not so waxy.
14.3	1.0	78.0	0.881	10	Black, waxy with thin gray streaks.
15.3	1.0	66.5	0.880	9–10	Black, waxy with fewer gray streaks.
16.3	1.0	52.5	0.891	4–5	Black, not so waxy, zone of "alum" pockets.
17.9	1.6	44.8	0.887	4–5	Black, not waxy.
19.6	1.7	46.9	0.905	2+	Black, not waxy.
21.0	1.4	22.6	0.924 (?)	0	Black and dark gray streaks, resists erosion.
22.6	1.6	19.9	0.899	1—	Tan and gray, erodes rapidly.
24.7	2.1	35.7	0.899	1	Black and gray, resists erosion.
27.4	2.7	20.4	0.904	0	Tan and gray with 1-in. sandstone, erodes rapidly.
29.4	2.0	45.8	0.890	1+	Hard black.
31.4	2.0	45.1	0.884	1+	Hard black.
33.4	2.0	34.4	0.884	1—	Brown, erodes to gray and tan.
34.6	1.2	25.7	0.877	0	Black.
36.6	2.0	27.1	0.893	0	
38.5	1.9	22.7	0.899	0+	
39.7	1.2	36.6	0.903	2	
40.9	1.2	12.2	0.901	0	
42.3	1.4	16.4	0.889	0	
44.3	2.0	36.3	0.878	2—	Black with small hard cells.
47.3	3.0	30.0	0.885	1	Black with gray bands—hard.
49.3	2.0	33.7	0.884	1—	Hard black—small cells.

	Feet	Gallons per ton
Yield of total section	69.1	30.47
Yield of section below marker	49.3	33.29
Yield of section above base of marker	19.8	23.45
Yield of section below marker, excluding top 3.5 feet	45.8	34.77

* Relative coking tendency is shown by an arbitrary numerical scale in which 0 indicates no coking tendency, and 10 indicates coking so strong that the assay charge forms one solid mass, shrinks to less than half its original volume, and adheres tenaciously to the retort walls. Shales having a coking number greater than 3 have so far always given trouble in both experimental retorts.

duced have not been determined as satisfactorily as with the Pumpherston retort.

The amount and composition of waste or surplus gas produced by the N-T-U retort depend on the nature of the shale retorted and on the volumes of air and return gas supplied to the retort. In a typical run with a charge of 29 tons, the total volume of waste gas was 568,000 cu. ft. The net heating value of the gas was 35 B. t. u. per cu. ft.; it is low because of the presence of the nitrogen from the combustion air and the carbon dioxide from the combustion of the fixed carbon and decomposition of the carbonates of the shale.

Value of Experimental Plant Data

In selecting retorts, the Bureau of Mines had no intention of establishing the merits of or substantiating the claims for any particular retort or process. The purpose of the work was to take the step from laboratory to semi-commercial shale-oil production, in which the fundamental data obtained by laboratory study would be tried out and amplified or modified, if necessary, in large-scale production. Study is being made of two basically sound retorting methods—not of two retorts, except as necessarily incidental to the investigation. The writer hopes that the work will furnish data on which reasonably accurate estimates of the costs of producing shale oil may be based. He expects that the results of the work will lead to suggestions as to retort design and to methods of operation that will be particularly suitable for American shales and economic conditions in America. The work already has indicated that certain design features of both retorts might advantageously be modified. It is not impossible that some of the best features of the two methods might be combined in retorts of design materially different from either of those now in use at the plant. Valuable information on the mining characteristics of oil shale and on drilling, shooting, and crushing have been obtained and will be presented with retorting and refining studies in publications of the bureau.

Refining Studies

Large quantities of shale oil have been made available for refining studies by the operation of the two large retorts. Oils from both retorts have been studied at the experimental refinery at Boulder and by various petroleum-refining companies which have agreed to furnish the bureau with the results of their investigations of the oils. A summary of the results of work thus far reported follows:

(1) The oils produced by the two retorting methods are essentially similar, except that the oil from the internally fired retort contains a smaller amount of secondary-decomposition products than that produced by the externally fired retort.

(2) The American refining companies which cooperated in this study consider the shale oils inferior to petroleum for refining purposes.

(3) The shale oils are deficient in the lighter constituents of gasoline fractions. (This deficiency would be reduced by adding retort scrubber naphtha.)

(4) The sulphur contents of the crude and distilled fractions are high and because "of the high sulphur content even after heavy acid-treatment, it does not appear that present petroleum-refining methods would yield products which will entirely meet present specifications."

(5) The lubricating oils finished from the crudes are of low viscosity.

(6) Refining losses on all products are high as compared with similar petroleum products.

(7) Cracking yields are less than those obtained from petroleum distillates or residuums.

(8) Scottish shale-oil refinery methods yield from the American shale oils products inferior in quality and quantity to oils produced from Scottish shales.

(9) Detonation tests have been made on straight-run shale gasolines heavily treated with sulphuric acid to remove sulphur. These fuels had strong tendencies to detonate in internal-combustion engines. Incidental to the removal of sulphur, much of the unsaturated compounds, which might be expected to have valuable antiknock properties, were removed also. Detonation studies were made on shale gasolines produced by cracking. These fuels were treated only enough to give them specification color and make them light-stable. They contained most of the unsaturated compounds of the original pressure distillates. These lightly treated fuels apparently have valuable antiknock properties. It is evident that the successful refining of shale oil products hinges on the development (*Continued on page* 200)

FUSAIN*

By JOSEPH D. DAVIS †

***O*CCURRENCE of fusain in coal and its recognition—Microscopic detection described—Theories of formation discussed—Fibrous needlelike structure, chemically similar to charcoal—Distribution of fusian may affect coking qualities of coal**

THE term "fusain" was first adopted from the French by the American geologist, J. J. Stevenson, in 1911, according to Wheeler,[1] who applies it to that portion of coal resembling charcoal which he treats as one of the four ingredients of banded bituminous coal. The term has since been adopted by American writers; the Germans use it with slightly different spelling—namely, fusit. It is the equivalent of "mother-of-coal" and "mineral charcoal" of the earlier British writers. The English word fusain is also applied to "a crayon of fine charcoal" and is derived from the Latin root *fusus.*

OCCURRENCE OF FUSAIN IN COAL AND ITS RECOGNITION

Fusain is fairly widely distributed in coals of all ranks in varying amounts. It is almost always present in very thin sheets between the bedding planes of the banded coal constituents, and presents a jet-black silky appearance when the coal is split way. As fusain has little cohesive power the coal splits readily along the planes where it occurs. Such fusain bands often attain appreciable thickness—frequently ¼ to ¾ inch. Beet[2] has reported a maximum thickness of 2 inches for fusain partings and Sinnatt[3] has found it in the form of plates and lumps; one lump taken by him from the Peacock mine weighed 3¾ pounds. Bode[4] has found it in coal balls. Sinnatt[3] states that fusain occurs in two forms; "the first a hard compact variety occurring rather rarely, which can not be pulverized by pressure of the fingers; the second type is the common substance"—that is, a very friable, easily pulverized material. The writer has also encountered the two types of fusain in the same coal bed and has observed that the hard variety contained considerable calcium carbonate, which probably entered the material *in situ* by infiltration. Sinnatt further remarks that the layers of fusain (soft type) usually contain less moisture than the coal (or lose it more readily on exposure) and when exposed they quickly change to flocculent powder so that the fines of the coal as mined are likely to contain a major proportion of this substance.

Detection

Fusain is a steely black substance, and when reasonably pure it may be readily distinguished from bituminous coal in which it occurs. The "streak" of coal is brown, whereas that of fusain is black. The difference in color is easily apparent in fine powders of the substances. The microscope, however, offers a more certain means of identification in the hands of an experienced observer. The requisite experience is not extensive; a few hours study of known samples of fusain and of known mixtures of coal and fusain are sufficient. The writer prefers to use a binocular microscope of about 70 diameters magnification with the sample in powdered form, lighted direct. The fusain particles under these conditions will present a fibrous appearance, or in the case of the larger particles that of bundles of fibers. If the sample is chiefly coal, detection of the fusain by this method becomes difficult. With coal of 60-mesh size it is perhaps possible to detect fusain when there is as much as 6 percent of it present. When it is desired to detect small inclusions of fusain in the coal mass, the method involving the making of thin sections of the coal and examination under higher magnification by transmitted light is available. This method, however, requires special training in the making of sections and more experience in the use of the microscope than is usually possessed by a research chemist. Reinhardt Theissen, microscopist and research chemist of the United States Bureau of Mines, is especially skilled in the use of this method and has developed it to a high degree. *Figure 1* shows particles of fusain as they appear by direct light at low magnification and *Figure 2* is a photograph of a thin section of coal, containing fusain, by transmitted light at about 200 diameters magnification.

Cooper[5] determined the amount of fusain in samples of coal from 15 mines—three anthracite, three anthracitic and nine bituminous coals. The fusain varied from 1.5 to 4.0 percent in the first sample, 1.0 to 4.5 percent in the second, and 0.0 to 2.5 percent in the third. Sinnatt[6],[7] states that the fusain content of coal may make up 5 percent of the coal bed; this agrees with the above figures.

Separation and Determination

Apparently no very precise methods for separation and determination of fusain are available. Beet,[2] in presenting analyses of various fusains, remarks that the results

> alone suffice to show that they [the fusains] contained in many instances considerable proportions of material which, though not recognizable as coal, was not true fusain. It seems probable that the conflicting results that have been elsewhere reported for the analysis of fusains (as compared with the coals with which they were associated) and for its properties, such as rate of oxidation, may be due in part to the samples examined being mixtures of fusain with more or less coaly matter.

The writer of this present paper, knowing the difficulty of obtaining samples of fusain which will not show small quantities of foreign matter under the microscope, believes that this is an important consideration which should be

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[1] Spontaneous Combustion of Coal, by M. C. Stopes and R. V. Wheeler, Bull. 1. *Fuel*, 124 pp., 1924. Colliery Guardian Co., London. See also Formation of Coal Beds, by J. J. Stevenson, Proc. Amer. Philos. Soc., vol. 50, 1911; vol. 51, 1912; vol. 52, 1913.

[2] Analyses of Fusain, by A. E. Beet, *Fuel* 3, 390-392 (1924).

[3] Coal and Allied Subjects, by F. S. Sinnatt, A. Grounds et al. 205 pp. H. F. & G. Witherby, London, 1918.

[4] New Observations on the origin of Fusinn, by H. Bode, *Fuel* 7, 487-492 (1928).

[5] Investigation of the Banded Structure of a Fifeshire Coal, by James Cooper, Proc. Roy. Soc. Edinburgh, 44, 88-96 (1924).

[6] Fusinn, by F. S. Sinnatt, Trans. Ming. Eng. (London) 62, 156 (1921).

[7] Fusian, by F. S. Sinnatt, Coll. Guard. 122, 1153-1154 (1921).

TABLE III.—ANALYSES OF FUSAINS AND COALS ASSOCIATED WITH THEM

Coal	Sample	Moisture	Ash	Volatile matter	Organic volatile	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	B.t.u.
				(a) Analyses Reported by Beet,[2] Percent							
Barnsley	Coal	3.2	2.3	35.3	.....	81.7	5.16	10.73	1.24	1.17	......
Yorkshire Main	Fusain	2.4	8.4	13.4	.....	93.7	2.71	2.61	0.44	0.54	......
Ellcoal, Shields	Coal	10.8	1.3	35.9	.....	81.0	4.91	11.73	1.37	0.99	......
Collery	Fusain	2.5	5.5	20.2	.....	85.75	3.34	9.34	0.46	1.11	......
Barnsley	Coal	6.5	2.7	36.6	.....	80.0	4.8	12.68	1.46	1.06	......
Top Softs	Fusain	2.1	15.2	20.6	.....	93.43	2.23	2.49	0.40	1.45	......
Top Slipper	Coal	8.0	4.4	37.7	.....	79.6	4.77	12.58	1.18	1.87	......
Hamstead	Fusain	2.9	18.0	17.7	.....	89.43	3.26	6.11	0.51	0.69	......
Dysart Main	Coal	10.5	4.5	39.6	.....	78.80	5.09	14.68	1.08	0.35	......
Balgonie	Fusain	4.3	7.0	20.5	.....	86.05	3.39	9.08	0.61	0.37	......
Deep Seam	Coal	6.0	4.6	39.6	.....	80.9	5.41	11.72	1.08	0.89	......
Aldridge	Fusain	1.9	5.1	13.7	.....	90.48	2.83	5.74	0.44	0.51	......
Ell Seam	Coal	7.4	3.1	39.7	.....	80.20	5.14	12.31	1.47	0.88	......
Bog Colliery	Fusain	1.6	2.0	14.0	.....	92.43	2.86	4.04	0.41	0.26	......
Robins Seam	Coal	8.9	8.3	39.8	.....	73.50	4.82	15.34	1.48	4.86	......
Cannock	Fusain	2.2	15.2	17.0	.....	85.97	2.93	4.91	0.39	5.80	......
Deep Softs	Coal	9.8	7.7	40.4	.....	75.60	4.71	16.50	1.88	1.31	......
Mapperly	Fusain	2.3	9.7	16.4	.....	90.25	2.98	4.64	0.48	1.65	......
Deep Softs	Coal	7.6	13.2	40.9	.....	74.0	4.80	14.51	1.51	5.19	......
Derby	Fusain	2.6	6.4	17.9	.....	89.53	3.0	5.79	0.67	1.01	......
				(b) Analyses Reported by Sinnatt[3]							
Bacon Mine	Coal	2.16	3.72	40.19	38.03	76.96	5.01	10.63	1.62	1.98	14,050
Upper King	Fusain	1.23	10.86	19.9	18.67	77.30	3.82	5.47	0.79	1.62	13,423
Mountain	Coal	2.78	3.52	26.46	23.73	.....	....	.....	....	....	......
Mine	Fusain	0.45	7.14	9.52	8.87	.....	....	.....	....	....	......
Hell Hole	Coal	1.94	2.67	35.0	33.06	82.25	5.34	7.05	1.62	1.02	14,589
Mine	Fusain	0.70	6.71	15.97	15.27	83.26	3.27	2.51	0.84	3.36	14,015
Arley	Coal	1.92	3.23	35.34	33.42	82.32	5.51	5.89	1.54	1.45	14,740
Mine	Fusain	1.40	4.72	13.21	11.81	84.63	3.24	4.47	0.76	2.11	14,700
Ravine	Coal	2.42	4.05	36.56	34.14	78.42	5.24	8.41	1.50	2.28	14,360
Mine	Fusain	1.50	11.52	15.80	14.30	76.85(?)	3.47	4.69	0.73	2.85	12,880
				(c) Miscellaneous Analyses. Fixed Carbon							
Top Hardy[21]	Vitrain	9.90	0.90	29.43	59.77	71.77	4.75	10.26	1.15	1.27	......
	Fusain	3.10	13.80	16.87	66.23	72.47	3.19	5.97	0.79	0.68	......
Winterslag[27]	Vitrain	0.7	3.1	20.49	75.71	84.37	4.43	4.71	1.80	0.85	......
	Fusain	0.6	11.4	14.08	73.92	79.02	3.61	3.70	1.00	0.69	......
Andre[27]	Vitrain	0.6	2.1	28.90	68.40	84.85	4.48	4.86	2.06	1.10	......
Dumont	Fusain	0.4	7.4	12.91	79.29	83.62	3.14	3.78	0.96	0.76	......
Limbourg[21]	Vitrain	0.6	3.9	26.45	69.05	82.03	4.20	6.40	1.95	0.99	......
Meuse	Fusain	0.4	10.8	13.76	75.04	77.61	3.28	4.08	2.74	1.03	......
Bruckenberg	Bright coal	8.40	2.27	29.30	60.03	75.02	4.72	7.68	1.46	0.45	......
Coal[27]	Fusain	1.38	30.58	27.02	48.42	56.03	2.36	8.93	0.39	0.33	......
English	Vitrain	12.6	1.2	38.6	.....	78.5	5.15	13.9	1.33	1.12	......
Coal[8]	Fusain	3.9	10.0	22.6	.....	84.7	3.9	9.7	1.05	0.65	......

borne in mind where published properties and analyses of fusain are concerned. Brief mention of methods used for determination of fusain will suffice here; readers interested in going deeper into the subject are referred to the original papers. Sinnatt[3] calculates the fusain content of a mixed sample from its volatile-matter content; the volatile matter of fusain and that of coal are known from analyses of pure samples of these constituents of the mixture. Stern[8] uses a similar method. Beet[2] separates by screening. Lessing[9],[10] uses the principle of eleutriation, "float and sink" methods and disintegration by acids—for example, by sulphur dioxide.

Origin of Fusain

Authorities on the origin of coal are not agreed as to the manner of formation of fusain. Obviously it was woody matter originally (this is apparent from its structure), but the nature of the carbonizing process it went through before arriving at its present state is not clear. Because of its presence in all ranks of coal in the same form it seems that the carbonizing process must have been complete in the early stages of coalification—that is, in the peat bogs.[11] The oldest and simplest theory to account for its presence in coal is due to Daubreé[12] who believes thta it originated in forest or bog fires. Jeffrey[13] in America and Bode[4] in Germany are authorities preferring the forest fire theory, whereas Theissen and White[14] are inclined to think that fusain was formed by special conditions of decay in the peat bog. Similar ideas are held by Stach[15] in Germany. The following quotation from Theissen[16] will illustrate the reasoning of those opposed to the forest fire theory:

Plant Matter Buried Alive

It has been mentioned that a considerable number of trees (in peat bogs) recline more and more until they lie flat and eventually are buried alive. Secondly, the root complex of the flora of the swamp, while they never penetrate far

[8] Fusain and Its Estimation in Coals, by H. Stern, Chem. and Min. Rev., 13, 101-102 (1920).

[9] Inorganic Constituents of Coal, by R. Lessing, J. Soc. Chem. Ind., 44, No. 24 277T (1925).

[10] Disintegration of Coal by Acids, by R. Lessing, Iron and Coal Trades Rev., 105, 724-725, 776 (1922).

[11] Coal, by E. S. Moore, John Wiley & Sons Inc., New York, p. 101 (1922).

[12] A. Daubreé, Compt. Rend. 19, 126 (1844).

[13] Origin of Fusain, by E. C. Jeffrey, Jour. Geology, 23, 218 (1915).

[14] The Origin of Coal, by David White and Reinhardt Theissen, U. S. Bureau of Mines Bull. No. 38, 304 pp. (1913).

[15] The Origin of Fusain, by E. Stach, *Fuel* 6, 403-410 (1927).

[16] Microscopical Constitution of Coal, by Reinhardt Theissen, Trans. Amer. Inst. Ming. & Met. Eng., 71, 35-116 (1925).

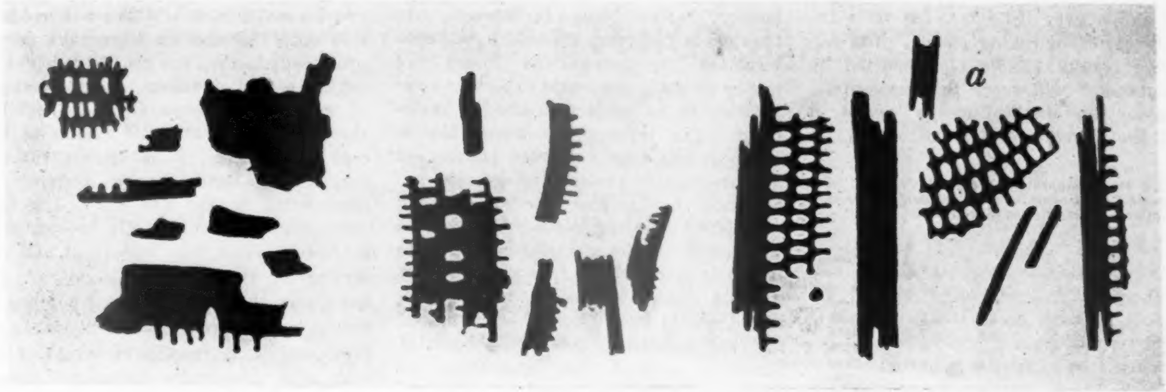

Figure 1. Particles of fusain (X70)

into the peat stratum below, living roots remaining relatively near the surface by the time they die are covered by a considerable amount of débris. Such plant matter evidently does not go through the same phases of decay as those that decay on the surface with complete access of air. * * * Decay under such conditions is probably extremely slow. Fungi are excluded at all times and reasoning from the chemistry of wood decay, cellulose fermenting bacteria only can be active, living under strong reducing conditions, fresh peat being a strong reducing agent. We may have here a solution of the origin of mineral charcoal.

McKenzie Taylor[17] accounts for the formation of fusainlike material by anaerobic decay in peat under clay overburden which is impervious to air.

One objection to the forest fire theory may be mentioned: If this were the manner in which fusain was formed, one would expect to find it more localized and not so widely distributed in the bedding planes of the coal. Furthermore, one would expect to find occasional large logs in charred condition—crushed perhaps, but remaining largely *in situ*. The forest fire school believes that charcoal formed in the bog may well have been disintegrated and widely distributed by wind and water currents. The present writer does not venture judgment as to the comparative merits of these theories; they are presented merely to indicate the trend of thought of best known investigators in the field.

[17] The Replaceable Bases in the Roofs of Bituminous Coal Seams of Carboniferous Age, by E. McKenzie Taylor, *Fuel* 7, 66-71 (1928).

[18] Examination of the Banded Constituents of a Derbyshire Coal, by H. D. Greenwood, J. Soc. Chem. Ind., 43, 363-6T (1924).

Figure 2. Fusain in coal (X200)

Properties of Fusain

Physical

As previously indicated, fusain has fibrous or needlelike structure, and for this reason when mixtures of coal and fusain are passed through a sieve of given mesh the fusain particles will be the larger because of their great length compared to their thickness. Fine sizes of fusain (150 mesh and finer) do not have as strong a tendency to agglomerate as do fine coal particles. The mutual attraction of coal particles (surface forces) in air is greater than that of fusain particles. Very fine coal particles have a tendency to stick to fusain, thus obscuring its structure in a mixture under microscopic examination. The writer has been unable to find specific gravity figures for fusain except in the case of one sample for which the true specific gravity found was 1.53. Greenwood[18] gives the following comparative figures (*Table I*) for cokes from fusain, durain, clarain, and vitrain.

TABLE I.—True and Apparent Specific Gravities and Porosity of Cokes from Banded Constituents of Coal, According to Greenwood

	Fusain	Durain	Clarain	Vitrain
True specific gravity	1.980	1.877	1.880	1.878
Apparent specific gravity	1.980	0.980	0.600	0.553
Percent porosity	0.0	48.9	68.0	70.7

Sinnatt[3] observes that

fusain ignites with considerable ease at a low temperature and continues to smoulder at a dull red heat. * * * The fact that little odor is produced adds to the dangers associated with the combustion of fusain, as practically no indication is afforded of the substance being on fire.

Chemical

As fusain is very similar to charcoal it will be expected to have very similar chemical properties; this is true except as it may have become mixed with or absorbed both organic and inorganic materials of the coal bed. It always yields, on destructive distillation, considerable

gas and a very little tar, but it is entirely devoid of coking power. The following results (*Table II*) reported by Greenwood[18] will serve to illustrate its behavior on distillation as compared with that of other coal constituents:

TABLE II.—Comparative Yields of Products from Banded Constituents of Coal on Destructive Distillation, According to Greenwood

Sample	Coke, pct.	Tar, pct.	Liquor, pct.	Gas, c.c. per 10 grams
Vitrain	65.7	7.7	8.0	3465
Clarain	65.4	8.9	7.5	3390
Durain	62.3	12.1	5.9	3280
Fusain	80.3	3.6	4.8	2400 (very lean)
Coal, average sample	66.8	8.9	7.5	3100

Sinnatt and Slater[19] have brought out the interesting fact that low-temperature propagation of combustion will not take place in 60 to 90-mesh coal alone, but if some fusain is added, combustion propagates. One supposes that the rapid low-temperature absorption of oxygen by fusain is the controlling factor; the fusain is an accelerator, so to speak, which causes combustion to propagate in coal normally too coarse to exhibit this phenomenon.

Fusain is practically insoluble in organic solvents ordinarily used in the extraction of coal, and it is not hydrogenated to an appreciable extent under pressure. Shatwell and Graham[20] give the following comparative figures for hydrogenation of the banded constituents of a bituminous coal: Clarain gave 56.2 percent of oil soluble in ether in 3 hours' treatment and durain gave 37.5 percent soluble after 4 days' treatment, whereas 95 percent of the fusain remained insoluble after 4 days.

Fusain is not considered promising as a decolorizing agent, doubtless because of the mineral matter and coal substance already absorbed by it.

Composition

The composition and properties of charcoal depend upon the kind of wood from which it is made,[22] the degree of carbonization,[21] and the conditions of exposure[23] after being carbonized. As fusain is a very similar material (whether we accept the forest fire theory or not), one would expect its composition to be subject to similar variations. The influence of conditions to which it has been subjected subsequent to formation is probably of greater importance than in the case of charcoal, because of the long periods involved in coalification of the material in which the fusain is distributed. One would expect that its volatile matter content, for example, would vary directly with that of the coal substance; this is the basis of Sinnatt's method for estimation of fusain, previously referred to. The relation is not necessarily precise, however, because the volatile matter of the fusain itself may vary as noted above and it may not have attained equilibrium as regards absorption of volatile matter from the coal. Furthermore, and this seems most important, as Beet[2] has remarked, it is extremely difficult to obtain coal-free fusain for analysis. From analyses examined by the present writer it appears that, in general, the higher the volatile matter of the coal the higher will be that of the fusain. A number of analyses of fusains together with analyses of coals in which they are associated are given in *Table III* to show the general relation, but it is not considered that the data available are sufficient to prove the case.

It will be noted from *Table III* that the moisture, oxygen, hydrogen, and nitrogen content (except in one case) of the coal is higher than that of the fusain, as would be expected from what has been said in the foregoing. The sulphur is sometimes higher in the fusain than in the coal and sometimes lower. As pyrite is often found associated with fusain one would expect to find high pyritic sulphur in coals where the sulphur content of the fusain is high. The total carbon of the fusain is higher than that of the coals, but sometimes lower than that of the vitrains. The volatile-matter content is always higher for the coal than for the fusain, but it can be seen that coals highest in volatile matter are not always associated with fusains of highest volatile matter. This in itself should not be taken, however, as argument against the use of the volatile-matter ratio for determination of fusain, provided that the volatile matter of pure coal and that of pure fusain for the coal in question are known.

PRACTICAL SIGNIFICANCE OF FUSAIN IN COAL

As fusain has no coking power itself, it undoubtedly detracts from the coking power of the coal in which it occurs. However, as it is usually present in small quantities, it is difficult to see how this could become an important factor practically, unless the coal is deficient in coking power or unless, due to methods of mining and preparation for coking, there is concentration of fusain in the coal as charged. It is known, for example, that fusain has a tendency to concentrate in the fine sizes. In this connection a point recently brought out by Rose[25] seems very important and deserving of thorough investigation. He has shown that segregation of patches of fusain in coke greatly weakens its structure, and it is readily recognizable as such with practically unchanged structure in the coke. It seems, therefore, that the distribution of fusain in coal may have a much more important bearing on the quality of coke produced than its amount. Thus, relatively thin sheets of fusain in the coal may affect the strength of a relatively large proportion of the sized lumps of coke as marketed.

Tideswell and Wheeler[26] believe that the presence of fusain may increase the tendency of a coal to heat spontaneously because of its rapid absorption of oxygen at low temperature. This, however, has not been substantiated by other investigators.

There is no doubt that fusain increases the dustiness of coal because of its great friability. It is the smudgy black material found on lumps of coal along their bedding planes and easily rubs off, soiling the hands on handling. It dries quickly and falls from the coal in the form of dust.

BUREAU of MINES OIL-SHALE PLANT
(From page 196)

of methods of reducing sulphur without reducing the percentage of valuable hydrocarbon constituents, or on the possible removal in the future of present-day low-sulphur tolerances.

The results of the refining studies do not favor shale oil as a substitute for petroleum. The need for shale oil will probably not come in the immediate future; but when substitutes for petroleum are urgently needed, shale oil products will probably be seen in a more favorable light because (a) specification requirements may be less stringent, particularly as regards sulphur contents and physical appearance, than at present, (b) refining methods will probably be developed, particularly for shale oil, and (c) retorting methods may be developed to yield crudes superior to those discussed in this report. The fact is worth emphasizing that refining really begins with the retorting process.

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[19] The Propagation of a Zone of Combustion in Powdered Coal, by F. S. Sinnatt and L. Slater, *Fuel* 2, 211-216 (1923).

[20] Hydrogenation and Liquefaction of Coal, by H. G. Shatwell and J. I. Graham, *Fuel* 4, 25-30 (1925).

[21] Explosives, by Arthur Marshall, vol. 1, p. 67, P. Blakiston's Sons & Co., Philadelphia, 1917.

[22] Wood Distillation, by L. F. Hawley, 136 pp. The Chemical Catalog Co., Inc. 1923.

[23] Hood, O. P. Marks' Mech. Engrs. Handbook, p. 609. McGraw-Hill Book Co., New York, 1916.

[24] Banded Coal, by H. Winter, *Fuel* 7, 52-63 (1928).

[25] The Selection of Coals for the Manufacture of Coke, by H. J. Rose, Pamphlet, 41 pp., published by The Koppers Co., Pittsburgh, Pa., 1926.

[26] Tideswell, F. V., and Wheeler, R. V. Fusain and Its Oxidation: Studies in the Composition of Coal, paper delivered before A. I. M. & M. E., New York, Feb., 1926. Jour. Chem. Soc., vol. 127, 1925, pp. 125-132; Chem. Abs., vol. 19, pt. 1, 1925, p. 1484.

COAL STORAGE

By A. J. Hoskin *

Quantity of Heat Generated Is Proportional to Quantity Of Oxygen Involved—Disintegration Of Pyrite Hastens Decrepitation Of Coal—Exudation Of Gas Discussed—Solution Lies In Limitation Of Air In Voids Of Storage Pile

No doubt each of us has witnessed a spontaneous fire in a coal pile. Some of us may have seen a number of these fires and have been so impressed by the mysterious phenomena that we assume them to be commonplace in storage practices. However, facts contradict such an impression. These self-started fires are really scarce, if their number be compared with the many coal storages that are made continually. Furthermore, their frequency and their costs are diminishing, due to the earnest efforts of progressive operators. Persons who hesitate still to store Indiana coal because they cannot feel assured of *absolute* safety against fire would do well to enroll in similar worthy efforts.

Numerous theories have been proposed to account for these autogenous fires, and scientists have conducted many researches that have been intended to either substantiate or discredit these theories. This paper is an attempt at a brief, non-technical presentation of some of these theories that seem fundamental in the subject. This will be followed by descriptions of two up-to-date Indiana practices that are based upon the consideration of these theories.

Oxidation

One universally accepted theory is that stored coal becomes heated by its own *oxidation*, that is, by the combination of some of its substance with oxygen from the atmosphere. While there is a lack of knowledge as to the exact nature of the reactions between coal and air at the ordinary temperatures which prevail in a normal, out-of-door pile, there is no doubt that these reactions generate heat. It has been proved that the quantity of heat generated is proportional to the quantity of oxygen involved, regardless of the rate of the reaction.

It is believed that some oxygen is absorbed or adsorbed by the coal as by a physical or surface reaction; that other oxygen unites chemically, to form the oxides of carbon; and that *each* type of reaction produces heat. Ordinarily the heat escapes by radiation, into the atmosphere or the ground, sufficiently fast to prevent any substantial rise in temperature; but occasionally conditions will be propitious for either an exceptionally rapid oxidation or a restricted removal of the heat, so that a fire ensues.

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Sulphur

Early in the history of coal storages, the blame for occasional fires was laid upon *sulphur* or pyrite. This accusation was logical because sulphurous odors were noted during the fires, and because the pyrite altered considerably whenever a pile heated even though it did not burn.

Pyrite does oxidize at normal temperatures and with the generation of heat but, in this respect, it differs little from the other substances in bituminous coals, while also there is not much difference between the respective thermal effects. The oxidation of pyrite may indeed produce a dangerous temperature, but the same effect may be attained from the oxidation of an equivalent amount of carbon. It is easy to figure that the heat resulting from the complete oxidation of the sulphur in a coal that contains six percent pyrite (or about three percent sulphur) will create a critical temperature, but the argument proves nothing against sulphur, because the complete oxidation of six percent of any other fraction of the coal will produce the same result.

Pyrite decrepitates under the influence of abnormal heat and, when doing so, it disintegrates its coaly matrix. To this extent, then, it renders the mass of the coal pile more susceptible to ignition; and this rather innocent act now is regarded generally as sulphur's sole guilt in spontaneous fires.

Inherent Gas

Any fresh bituminous coal exudes a *natural gas* which is combustible and hence has heat value. It is the same gas (marsh gas) that causes disastrous explosions in coal mines. Unmined coal is somewhat saturated with this methane whereas old or weathered coal is practically destitute of it. The rate of emission is at its maximum when the coal is freshly broken from the seam, and it is higher for the finer grades than for the coarser grades. Fresh screenings or mine-run yield this gas rapidly during a comparatively short period which varies with different seams, districts, and mines.

This gas, which is part of the socalled volatile combustible in coal, oxidates readily and with the production of heat. Therefore, it ought to be regarded as one of the active reagents in spontaneous heating. While the relative responsibilities of the solid and the gaseous fractions of a bituminous coal, in the autogenuous generation of heat, are seldom considered, it seems probable that they are closely proportional to the respective amounts of such substances. Fresh coal heats spontaneously, more rapidly than does old coal, and this attributable to the more rapid emission of this gas by the fresh coal.

A mass of coal seldom fires if it survive the early period of storage during which it liberates most of its highly volatile component, this inherent gas. Numerous authorities believe that any mass of self-heated coal that, having reached a dangerous temperature, is cooled successfully, is thereafter immune from heating. If this be true, it may be that much of the early oxidizing reaction is with this highly combustible gas, rather than with the solid substance of the coal. This does not infer that the solid portion of the coal does not unite with oxygen, but is a suggestion that such a reaction is but partially responsible for the heating of the coal during the first few weeks after its mining. This might explain why coal that has undergone intermediate storage, or storage in transit, gives little or no trouble with firing during its final storage.

Carbon-Dioxide Gas

When coal combines chemically with air, even though slowly,

various reactions produce amounts of carbon-dioxide (CO_2), carbon-monoxide (CO), and water (H_2O). There is such a strong affinity between coal and carbon-dioxide that the latter is absorbed greedily by the former. In fact, the gas is several times as soluble in coal as in water. It appears that coal unites first with oxygen to create carbon-dioxide and that it then absorbs this same product. The absorption is accompanied by a temperature rise which is greater than that resulting from straight oxygenation under like conditions.

It has been assumed usually that a coal pile cannot acquire more heat than can be ascribed to the oxygen reaction alone and that combustion is held in check, in most cases, by the resulting and supposedly inert gas, CO_2. But the new theory presents a different aspect of this phase of coal storage and suggests that the actual heat generation may be more than twice the amount that can result, theoretically, from straight oxidation.

Moisture

Water in coal is a factor whose responsibility for undersired fires is disputed. While it has emerged somewhat from universal suspicion, there are operators and investigators who still hold that water, in some form or other, has much to do with undesired coal-pile fires. It is difficult to escape such a prejudice because of our present inability to account satisfactorily for certain fires except upon the basis that they were related intimately to moisture conditions.

The water in coal is of two kinds. One kind is the ordinary or free water which makes the coal moist; while the other kind, known as structural, combined, or inherent water, is present even in air-dried or steam-dried coal. A theory is advanced that coal in storage acquires some of this latter kind of water and that the acquisition is accompanied by heating. The statement was made a few minutes ago that some water is created when coal, while still fresh or "green," is acted upon by the atmosphere, or is weathered, it being assumed that hydrogen, derived from the methane or marsh gas (CH_4) in the coal, combines with atmospheric oxygen. An early Federal investigation showed that the moisture content of a sample of Indiana coal increased from 3.58 percent at the start of 3.87 percent on the 183rd day of indoor storage. In other words the moisture content increased one-twelfth during the first six months.

Ordinary water may be derived as vapor from the air, and it is commonly applied by climatic agencies. If we are familiar with the phenomenon of heat when water is applied to quicklime, we may appreciate, even though we do not understand, how moisture may account for some of the heating in storage coal. Many instances of dangerous heat in coal piles have been attributed to the presence of common water, but it may be that there is another phase of water which is not understood.

A coal pile was laid down during wet weather upon clayey ground. Rainwater stood in wheel ruts and footprints that were buried by the coal. The bottom of the pile began to heat very early, and the pile steamed visibly within a few days. When dangerous heat had been indicated, the pile was opened up and numerous pockets were found to have undergone complete combustion as recorded by ashes.

Ventilation

By ventilation we mean a renewal of air supply. Some operators believe that proper ventilation prevents abnormal heating, while other operators condemn ventilation as the most potent factor in such heating. The favorable argument calls for a continual migration of fresh air in adequate quantity to absorb and remove the new heat as it is generated. The adverse argument holds that a dangerous temperature is attained in a coal-pile only because of a continual accession of fresh air.

Practices in storage based upon these opinions have netted unsatisfactory results. The full-ventilation notion is practically rejected, not because of theoretical error, but because certain limitations in every method that has been tried appear to induce rather than prevent dangerous heating.

A medium condition which may be termed restricted ventilation prevails in usual practices. An occasional fire indicates that air is available in sufficient quantity to permit a dangerous rise in temperature, and the usual explanation is that the air stored originally with the coal is augmented by fresh air that diffuses through the interstices of the pile, perhaps aided by wind pressure.

If, now, we reconsider the foregoing theories, we note that each one expresses a definite relationship between air and the coal substances. We observe that thermal rises can not be produced with sulphur, natural gas, carbon, carbon-dioxide, or water, without air. Air is foremost in any conception of oxidation or of ventilation. The deduction from all of this discussion, then, is that air is the star actor in all spectacular displays of autogenous firing in coal piles.

Kindling

One theory about coal storage is not given its deserved respect. Desired fires are started usually by igniting a substance that oxidizes rapidly at temperatures below those at which the regular fuel will oxidize or ignite. This starting substance we call kindling.

Many kinds of extraneous material find their way into coal during its mining and shipment or become admixed during or after the coal's placement in storage. With the exception of metal scraps, these foreign materials have lower ignition temperatures than the coal itself and therefore ought to be considered as potential kindling. Utmost precaution is required to see that storage coal does not contain bits of wood, paper, blasting fuse, rags, discarded clothing, waste (either dry or oily), charcoal, hay, straw, horse manure, weeds, leaves or twigs from trees, as well as remnants of coal from a former shipment or storage. Each of the mentioned types of kindling has been held responsible for coal-pile fires.

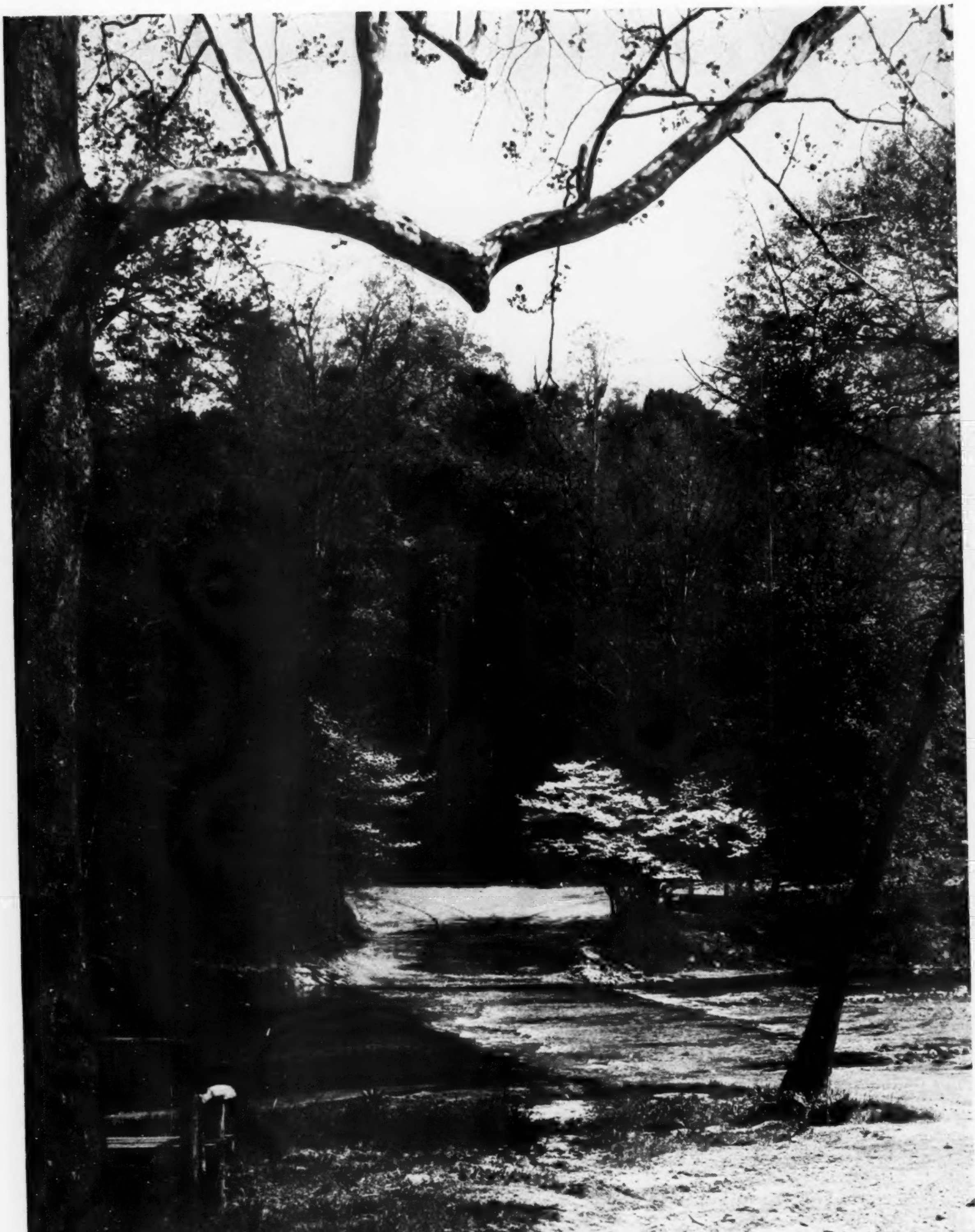
If the site has been used previously for the storage of paint, oil, tar, or other inflammable materials, the ground must be inspected carefully and any contamination removed effectually.

One constituent of Indiana coal itself, the natural charcoal or mother of coal, serves as tinder, but there is no practical way to remove it.

A common cause of fires is the storage of fresh coal upon or against a pile of older, seasoned coal. A certain outdoor coal pile was built of old, dried screenings that had been stored previously indoors and were considered thoroughly "seasoned." The pile was enlarged by the addition of fresh screenings. Although of the same grade and from the same mine, the two lots of coal were distinct in appearance, as might be presumed. Within 12 days after the storage of the second lot of coal, dangerous heat was discovered along the plane of contact between the two lots of coal. The following day steam and smoke arose vigorously from the pile and, upon its excavation, the coal was found in active combustion.

Another pile was planned to consist exclusively of screenings from one mine, and four carloads were received. Traffic interruption was responsible for the completion of the pile much later with screenings from a mine in a different district. During the placement of the first coal, a small, flat bench about three feet high had been left inadvertently extending along the side of the pile. The new coal was stocked upon and against this bench. Heating began early and continued by daily increasing increments to a dangerous point.

Still another pile contained coal exclusively from one mine, but part of the pile was old screenings while the balance was fresh mine-run. Sweating started soon and increased rapidly along the contact between the two grades of coal. (*Continued on page* 228.)



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"The streams, rejoiced that winter's work is done,
Talk of tomorrow's blossoms, as they run."

The CRACKING *of* COAL TARS*

By GUSTAV EGLOFF †

Coal great potential source of oil—Low temperature carbonization yields smokeless solid fuel, gas and tar—Tar can be commercially converted into motor fuel by cracking process—Operation of the cracking process described

World Resources of Coal and Coal Tar

COAL is the world's greatest known resource of combustible material and the potential source of enormous quantities of oil. The amount of oil which can be produced from the known coal areas reached astronomical figures. Through the cracking process, oil from coal could furnish over 1,000 billion barrels of gasoline. This supply would fill the needs of the 29,500,000 motor cars now in use throughout the world for over 2,500 years. The motor fuel would be of high anti-knock value, permitting its use in high compression motors, and materially increasing the mileage obtainable per gallon over that possible from ordinary gasoline.

The world's reserves of bituminous coal, sub-bituminous coal, and lignite are estimated at 7,000,000,000,000 metric tons. The distribution of this vast accumulation is shown in Table I.

Compared with the total available supply of coal, the world's annual consumption, approximately one and a half billion tons, appears small. The 1927 world's production of coal, by continents and countries, is presented in Table II.

The utilization of coal in the future will probably be in a large measure through low temperature carbonization. This process has the advantage of producing a smokeless solid fuel, gas and relatively large amounts of tar. The tar can be commercially converted into motor fuel by the cracking process.

The potential yield of coke from the world's bituminous coal, semi-bituminous coal and lignite amounts to 3,000,000,000,000 tons. In addition to this amount the cracking of the tars produced in the low temperature carbonization operation would yield, besides gasoline, 350,000,000,000 tons of cracked coke.

Fuel gas would also become available in enormous quantities, both from the carbonization and from the cracking process. The potential production of this ideal fuel is estimated as 2,300,000,000,000,000 cu. ft.

The motor fuel available, were all the 4,000,000,000,000 barrels of tar derivable from the low temperature treatment of the world's coal supply subjected to the cracking process, would amount to over 1,000,000,000,000 barrels, sufficient as has been said, to supply the needs of the world's present motors for over 2,500 years.

The Operation of the Cracking Process

The operation of the modern cracking process will best be understood by a description following the flow chart of a typical installation. (The Mining Congress Journal, December, 1928, pages 397, 898.)

Cracking of West Virginia Low Temperature Coal Tar

Quite extensive studies have been made of the cracking of low temperature tars. A West Virginia bituminous coal retorted at low temperature produced 25 gallons of tar per ton, the tar having the following characteristics:

WEST VIRGINIA LOW TEMPERATURE COAL TAR

Specific gravity	1.074
Flash point, ° C. (Cleveland open cup)	107
Fire point, ° C.	127
Viscosity (Saybolt Furol) sec. at 25° C.	206
Water, percent	0.3
Distillation Analysis (A. S. T. M.)	
Pct. distilled over	° C.
10	196
20	246
30	267
40	290
50	307
60	343
70	356
80	368
90	393
End B.P.	393
Coke, percent by weight	11.3

This tar, cracked under 100 lb. pressure at an average temperature of 452° C. (845° F.), gave a yield of 30 percent of motor fuel containing 25 percent tar

TABLE II.—PRODUCTION OF COAL IN 1927 *
(In metric tons)

North America:	
Canada: Coal	12,329,539
Lignite	3,465,830
U. S.: Anthracite	73,164,000
Bituminous and lignite	471,556,000
Europe:	
Belgium	27,573,550
Czechoslovakia: Coal	14,582,000
Lignite	19,769,000
France: Coal	51,779,300
Lignite	1,067,400
Germany: Coal	153,597,600
Lignite	150,805,711
Saar	13,595,824
Hungary: Coal	784,154
Lignite	6,243,384
Netherlands: Coal	9,225,000
Poland: Coal	37,980,000
Lignite	77,000
Russia: Coal	31,000,000
Lignite	....
Spain: Coal	6,023,000
Lignite	412,000
United Kingdom: Gt. Britain	259,516,600
Asia:	
India, British	21,000,000
Africa:	
Rhodesia, Southern	908,744
Union of South Africa	12,500,000
Australia:	
New South Wales	10,700,000
Total	1,475,000,000

* From U. S. Bureau of Mines, 1928.

Estimates from a number of countries not listed are included in the total.

TABLE I.—WORLD RESOURCES OF BITUMINOUS AND SUB-BITUMINOUS COAL AND LIGNITE IN MILLIONS OF METRIC TONS *

	Bituminous coal	Sub-bituminous coal and lignite	Total resources	Pct. of world supply
North America:				
United States	1,955,521	1,863,452	3,818,973	55.2
Other countries	284,162	948,454	1,232,616	17.9
South America	31,397	....	31,397	0.4
Asia	760,098	111,851	871,949	12.6
Europe	693,162	36,682	729,844	10.6
Africa	45,123	1,054	46,177	0.7
Oceania	133,481	36,270	169,751	2.6
Total	3,902,944	2,997,763	6,900,707	100.0

* U. S. Bureau of Mines, 1927.

* From an address delivered before the World Power Conference.

† Research Laboratories, Universal Oil Products Company.

acids, or on an acid free basis, a 23 percent yield.

Cracking of Ohio-Indiana Low Temperature Coal Tar *

An Ohio-Indiana bituminous coal tar cracked at 100-lb. pressure and an average temperature of 427° C. (800° F.), gave 34 percent of motor fuel, or 22 percent on a tar acid free basis. The characteristics of the fuel and a summary of the cracking operation are shown in the table following:

CRACKING OF OHIO-INDIANA COAL TAR

Properties of the Initial Tar	
Specific gravity	1.0794
Flash point (Cleveland open cup)	54
Fire point, ° C	82
Viscosity (Saybolt Furol) sec. at 50° C	70
Tar acids, percent	27.5
Tar bases, percent	1.55
Distillation Analysis (A. S. T. M.)	
Pct. distilled over	° C.
10	208
20	232
40	291
30	257
50	348
60	372
78	366
Coke, percent by weight	22.0
Summary of the Results of Cracking	
Pressure distillate:	
Yield, percent of charging stock	40.8
Specific gravity	0.9230
Motor fuel:	
Yield, percent	33.9
Yield, on tar acid-free basis, pct	22.0
Coke, lb. per bbl	198
Gas, cu. ft	525

CRACKING OF UTAH COAL TAR

Properties of the Initial Tar	
Specific gravity	0.9831
Flash point, ° C. (Cleveland open cup)	82
Fire point, ° C	104
Viscosity (Saybolt Furol), sec. at 50° C	32
Tar acids, percent	29.0
Neutral oil, percent	61.0
Distillation Analysis (A. S. T. M.)	
	° C.
Initial B.P	183
Pct. distilled over	
10	249
20	281
30	314
40	349
50	366
60	378
70	385
80	390
90	394
End B.P	394
Coke, percent by weight	11.0
Cracking Conditions	
Pressure, lb. per sq. in	110
Liquid temperature, ° C	435
Products and Yields, Based on the Charging Stock	
Pressure distillate oil:	
Yield, percent	48.4
Specific gravity	0.8388
Coke, lb. per bbl	120
Gas, cu. ft. per bbl	618
PROPERTIES OF THE CRACKED GASOLINE (Free from Tar Acids and Bases)	
Yield, percent	24.1
Specific gravity	0.7874
Initial B.P., ° C	43
End B.P., ° C	224
Sulphur, percent	0.15
Benzol equivalent, percent	65.0
PROPERTIES OF FURNACE OR DIESEL OIL	
Yield, percent	17.9
Specific gravity	0.9315
Initial B.P., ° C	216
End B.P., ° C	399

Cracking of Utah Low Temperature Coal Tar

Low temperature tar, produced by retorting eastern Utah coal in a modified Scottish oil shale retort, was cracked at 100-lb. pressure and approximately 435° C. (815° F.), and gave a yield of 24 percent of gasoline free from tar acids and bases. The product was high in anti-knock properties, having a benzol value of 65 percent. A full statement of the cracking operation is presented in the preceding table.

Cracking of Neutral Oil Distillate *

In some low temperature operations, economic conditions make it desirable to recover tar acids and pitch from the primary tar. There is left a neutral oil distillate. Such neutral oils form excellent cracking stocks. Neutral oil from West Virginia bituminous coal, cracked under a pressure of 250 lb. and temperature of about 454° C. (850° F.), yielded over 50 percent of motor fuel. The benzol equivalent of the product was more than 50 percent. It constituted an excellent anti-knock fuel for high compression motors. The cracking operation produced approximately 84 lb. of coke per barrel of oil treated. The coke was practically ashless and had a calorific value of 16,000 B. t. u. per lb. Gas was formed to the amount of 840 cu. ft. per barrel of oil cracked and approximated 1,300 B. t. u. to the cu ft.

The analysis of the initial oil is shown in the table below:

PROPERTIES OF NEUTRAL OIL

Specific gravity	0.9478
Distillation Analysis (A. S. T. M.)	
	° C.
Initial B.P	199
Pct. distilled over	
10	232
20	249
30	263
40	277
50	291
60	302
70	321
80	338
90	368
98.5	374
End B.P	374

Remarks:
Trace of water.
3 percent at 210° C.
56 percent at 300° C.
Trace of coke.

Cracking of German Lignite Oils

Cracking tests were also made on a German lignite tar and a distillate oil from the tar. The tar was cracked at 90-lb. pressure and about 438° C. (820° F.). The yield of gasoline, on a tar acid and base free basis, was 38 percent of the oil treated. The distillate oil gave a 47 percent yield of gasoline at 150-lb. pressure and a temperature of approximately 454° C. (850° F.). The details of these runs are in the data below:

CRACKING OF GERMAN LIGNITE TAR AND TAR DISTILLATE

	Tar	Tar distillate
Properties of the In'tial Oils		
Specific gravity	0.9734	0.9265
Flash point ° C. (Cleveland open cup)		127
Fire point, ° C		149
Viscovity (Saybolt Furol), sec. at 25° C		12.5
Sulphur, percent	1.8	
Tar acid, percent	19.7	2.5
Tar bases, percent	1.0	
Neutral oil, percent	79.3	
Distillation Analysis (A. S. T. M.)		
Pct. distilled over	° C.	° C.
Initial B.P	241	235
10	301	280
20	324	296
30	346	308
40	367	316
50	377.8	328
60	378.3	338
70	379.4	353
80	378.9	357
90	357	392
Coke, percent by weight	7.5	
Cracking Conditions		
Pressure (lb. per sq. in.)	90	150
Liquid temperature, ° C	438	454
Products Derived from Cracking		
Pressure distillate oil, pct	64.4	67.1
Residuum	None	None
Coke, lb. per bbl	77	50
Gas, cu. ft. per bbl	767	571
Properties of Pressure Distillate Oil		
Specific gravity	0.7994	0.8132
Sulphur, percent	0.96	
Tar acids, percent	6.5	
Tar bases, percent	2.1	
Distillation Analysis (A. S. T. M.)		
Pct. distilled over	° C.	° C.
Initial B.P	24	
10	71	70.6
20	110	111
30	138	130
40	160	154
50	183	178
60	207	198
PROPERTIES OF THE CRACKED GASOLINE (Free from Tar Acids and Bases)		
Yield, percent	38.3	47.4
Specific gravity	0.7694	0.7762
Initial B.P., ° C	44	44
End B.P., ° C	224	227
Sulphur, percent	0.43	0.5
PROPERTIES OF GAS OIL		
Yield, percent	19.3	17.6
Specific gravity	0.8996	0.9554
Initial B.P., ° C	221	238
End B.P., ° C	366	374

Treatment of Pressure Distillation Derived from Cracking Lignite Tar

The pressure distillate oil may be treated by chemical reagents in the following manner, in order to produce a water white, light stable motor fuel:

(1) Thoroughly agitate the oil with 5 percent, by volume of 30° Bé. sodium hydroxide solution in order to remove the tar acids. Then settle the sludge and draw it off.

(2) Wash well with water.

(3) Agitate thoroughly with 5 percent by volume of a 10 percent sulphuric acid solution so as to remove the tar bases. Allow the acid sludge to settle. At this stage of the chemical treatment do not water wash.

(4) Treat (*Continued on page* 217)

* Egloff and Morrell, International Bituminous Coal Convention, Nov. 15, 1926.

LEGISLATIVE REVIEW

Congress session closes March 4—Many bills acted on before final adjournment — Uncompleted legislation goes over to next Congress — Extra session slated in April to revise the tariff—Mining bills receive consideration

AT NOON on March 4 the second and last session of the Seventieth Congress will come to an end. The three months' session, which began last December, was marked by continuous application by Congress to the task of disposing of as many legislative proposals as possible. In the final rush to clear its calendars both House and Senate disposed of many bills which have been pending during the last two years. Because of their controversial nature and lack of time to thresh them out, many of the bills died in committee or on the House and Senate Calendars. All uncompleted legislation will expire with the end of the Congress on March 4, and in order to receive further attention must be reintroduced in the new Congress.

For the purpose of revising the tariff President Herbert Hoover, the second mining engineer to rise to this position, and who will be inaugurated at noon on March 4, will call an extra session of the Seventy-first Congress. At this writing the date of the convening of this session is not definitely known, but reports are to the effect that the new Congress will be called in extra session early in April. The House Committee on Ways and Means has been conducting hearings since January 7, on proposed tariff changes and is expected to be in a position to bring in a new tariff bill when the extra session opens. While the extra session is to be called primarily to deal with the tariff and farm relief, the convening of such a session will permit the introduction of legislation of every character, and if the Senate and House appoint all of their committees these bodies will be in a position to consider such legislation. To all intents and purposes the extra session will be similar to regular sessions, although the leaders may not permit anything but tariff and agricultural legislation to be voted on.

After considering the matter for several sessions, Congress finally passed, and the President approved, a bill authorizing war mineral claimants to take their cases to the courts. Both House and Senate also passed a bill authorizing appropriations of $200,000 for investigations during the next four years by the Bureau of Mines and Department of Agriculture as to improved methods of recovering potash. The House passed a bill to permit patents to 320 acres of land containing copper and other minerals at depth without requiring a mineral discovery, but the measure met opposition in the Senate committee. Another proposal to meet opposition was one to forbid mineral claimants to obtain title to the surface of lands entered by them in the national forests. Two bills on this subject were introduced, one applying to all national forests and the other to forests in South Dakota. The South Dakota bill passed the Senate, but was held up in the House committee, and the Senate committee deferred action on the general bill, based on protests from western mineral interests.

A law was passed amending the stock-raising homestead act so as to protect mineral locations on lands covered by that act. A proposal was advanced to create a fund to assist cooperative associations in the production of mineral

fertilizers. Both Houses passed a bill authorizing Idaho Indians to submit to the Court of Claims suits for the value of gold mined on their lands prior to 1867.

A law was passed granting 100,000 additional acres of land for the benefit of the School of Mines and Agricultural College in Alaska. The House passed a bill granting 50,000 acres of land to aid in the construction of a hospital for disabled miners in Utah, but when the Senate passed the measure with an amendment making a similar grant for a hospital in Arizona, the bill was held up in the House.

Legislation was also passed by both Houses regarding mineral leases to lands of the Osage Indians in Oklahoma. These lands are to be subjected to a lease until 1958, but not more than 25,000 acres shall be leased annually. Provision is also made to compensate owners of land for pollution caused by mining operations. A bill was also passed by both bodies for reports by the War Department as to prevention of pollution of rivers in Pennsylvania and Ohio. Legislation was introduced for the sale of the remainder of the coal and asphalt deposits of Oklahoma Indians.

Congress was asked to continue until June 30, 1930, the Federal Oil Conservation board and the special government counsel who are prosecuting the naval oil reserve leases. Continuation of a fund under which the Government would call another conference of maritime countries to consider prevention of pollution of navigable waters was also requested.

A congressional committee, which has been investigating adjustment of land grants to the Northern Pacific Railroad, which involves the classification of mineral lands, has been unable to conclude its work, and Congress passed a bill continuing its activities until the end of the next regular session, and directing the Interior Department to withhold approval of the adjustment of the grant until June 30, 1930.

Legislation was proposed to create a congressional committee to recommend a policy concerning the public lands and national forests, and several Senators announced their intention of renewing in the next Congress legislation to turn over the public lands to the states in which they are located.

The session ended without action by Congress on any of the proposals which had been advanced during the past two years for regulation of the coal industry by a government commission. The last action on this matter was the appointment by the Senate Interstate Committee of a subcommittee of three members to digest the testimony taken during the past year in its investigation of conditions growing out of the suspension of union miners in Pennsylvania, Ohio and West Virginia. As the Senate committee was active in this matter, and as in a previous Congress the House committee was unable to report out a bill, the House Committee on Interstate Commerce took no action on the coal question.

Publicity of income tax refunds was advocated in the Senate and was not decided until the closing days of the session. Senator McKellar, of Tennessee, led a movement for public records of consideration and decision of tax refunds and under opposition of the Treasury Department revised his proposal on three occasions, the last one providing for public hearings and decisions of tax refunds of more than $10,000 by the Joint Congressional Committee on Internal Revenue Taxation.

Congress passed and the President approved a law forbidding interstate commerce in goods mined or manufactured by convict labor, but the law will not take effect until 1934, in order to permit prisons, both Federal and state, which require their convicts to produce various articles, to adjust themselves to the law.

While Congress at its recent sessions disposed of many legislative proposals, it left behind as many more suggestions which will be the basis for consideration in future sessions.

The following is a summary of recent action by Congress on numerous bills:

Mineral Lands

H. R. 15919. This bill authorizes patents to 320 acres of land containing at depth copper, lead, zinc, gold, or silver and their associated minerals, without a discovery of mineral, but requiring compliance with other conditions of the lode mining laws. Passed by the House.

S. 5269. This bill proposes to forbid mining locators in the Black Hills and Harney National Forests from acquiring any right to the surface of the land. The bill would restrict the locations to prospecting and mining and the taking of mineral deposits, and would forbid the occupation of the land for any other purpose than prospecting or mining. Passed by the Senate.

S. 1347. This bill permits claimants under the war mineral act to file within one year (until February 13, 1930) suit in the Supreme Court of District of Columbia to review decisions of the Secretary of the Interior on questions of law. The claimants would have the right of appeal to the Court of Appeals of the District of Columbia and the United States Supreme Court. Enacted into law.

H. R. 496. This bill authorizes appropriations of $50,000 for each of the next four years to enable the Bureau of Mines and Bureau of Soils to conduct chemical engineering and manufacturing research to determine improved methods and cheaper processes for recovering potash from leucite, alunite and other potash-bearing deposits in the United States. Passed by the Senate.

S. 3949. This bill amends the stock-raising homestead act by providing that the act shall not interfere with mineral locations or entries on lands under the stock-raising homestead law. Enacted into law.

S. 5691. Mr. Jones (Rep., Wash.), by request. This bill proposes to establish a fund of $1,000,000 in the Federal land banks from which to make loans to cooperative associations for the production of mineral fertilizer. The loans would be for 20 years without interest and would be made to cooperative associations organized for the purpose of leasing or purchasing lands for the production of mineral fertilizer by the feeding of lime, gypsum, granite and shale to poultry and livestock. Loans to the individual associations would not exceed $25,000. The bill authorizes the Interior Department to grant the associations the right to remove lime and other minerals for this purpose from the public lands. Banking and Currency.

H. R. 12520. This bill allows the Nez Perce Indians of Idaho to file claims in the Court of Claims for gold mined without authority from their land prior to the treaty of June, 1863, and its approval in April, 1867. These claims shall not exceed one-eighth of the gold mined. Passed by the Senate.

H. R. 10157. This bill grants 100,000 acres of land to aid the School of Mines and Agricultural College in Alaska. Enacted into law.

H. R. 15732. This bill grants 50,000 acres of land in Utah and a similar amount in Arizona to aid in establishing hospitals for disabled miners. Passed by the Senate.

H. R. 16527. This bill authorizes the Interior Department to purchase land for the Alabama and Coushatta Indians in Texas, subject to certain mineral and timber interests. Passed by the Senate.

Indian Lands

S. 2360. This bill continues until 1958 the restrictions against the land of the Osage Indians in Oklahoma. It provides that not more than 25,000 acres of their land shall be leased annually. Provision is made for arbitration of damages to private land by pollution from mining operations, with appeal to the Secretary of the Interior. Passed by the House.

H. R. 16990. Mr. Sutherland (Rep., Alaska). This bill validates mineral land entries by the Hammon Consolidated Gold Fields Corporation and by Andrew

Anderson and Fred M. Johnson in Alaska. Public Lands.

S. J. Res. 196. This resolution authorizes the President to negotiate with the governors of Oklahoma and Texas concerning the transfer of land involved in the decision of the Supreme Court as to the boundary line between these states in the bed of the Red River. Passed by the Senate.

S. 4691. This bill extends the provisions of section 18A of the leasing law to lands in Utah which were withdrawn by the President on October 4, 1909. The extension will be for 12 months after approval of this bill. Reported by the House Committee on Public Lands.

H. R. 13484. This bill authorizes the War Department to investigate methods to prevent the pollution of the west branch of the Susquehanna River in Pennsylvania and the Auglaize, Blanchard and Ottawa Rivers in Ohio. Enacted into law.

H. R. 17022. Mr. Hastings (Dem., Okla.). This bill provides for the sale of the remaining coal and asphalt deposits in lands of the Choctaw and Chickasaw Indians in Oklahoma. The lands are to be reappraised and sold to the highest bidder at public auction. The sale would be of both leased and unleased lands. If the lands are not sold at three public auctions, they would be offered to the highest bidder regardless of the reappraised value. The lands would be paid for within five years from sale. Indian Affairs.

H. J. Res. 413. Mr. Sproul (Rep., Kans.). This resolution proposes an investigation by the Federal Trade Commission as to whether the prohibition act is being violated by the sale by the Standard Oil Company of a process for recovering drinkable alcohol from industrial alcohol. Interstate Commerce.

H. R. 479. This bill authorizes the Interior Department to grant oil and gas prospecting permits and leases to the Oregon Basin Oil and Gas Company of Wyoming. Passed by the House.

Congressional Inquiries

S. Res. 320. Mr. Walsh (Dem., Mont.). This resolution proposed to approve a minority report from the Public Lands Committee criticizing the Interior and Justice Departments for delay in canceling a contract of the Sinclair Crude Oil Company for the purchase of government royalty oil from the Salt Creek Wyoming field.

H. J. Res. 398. This resolution directs the Interior Department to withhold approval of adjustment of land grants to the Northern Pacific Railroad until June 30, 1930, and continuing the joint congressional committee which has been investigating the grants until the end of the next regular session of Congress in 1930. Passed by the House and Senate.

H. R. 13899. This bill authorizes the issuance of patents to 160-acre tracts of land in Michigan which have been held under claim or color of title for more than 20 years on payment of $1.25 per acre. Passed by the Senate.

S. J. Res. 203. Mr. Steiwer (Rep., Oreg.). This resolution proposes the creation of a joint congressional committee of five Senators and five Representatives to study present laws regarding the public domain and the national forests. The committee is to report December 1 on a plan to divide the public land into separate classes with a view to its disposition into private ownership. The committee is to report recommendations for relief of the states affected by the fact that the forests do not yield taxes to the states. Public lands.

S. Res. 316. Mr. Ashurst (Rep., Ariz.). This resolution provides for an investigation by the Public Lands Committee as to the establishment of additional national parks and changes in boundaries of present parks, reporting during the next regular session of Congress. Public Lands.

S. Res. 303. Mr. Frazier (Rep., N. Dak.). This resolution increases from $30,000 to $60,000 the expenses of the Indian Committee in its investigation of Indian Affairs. The resolution also provides for continuation of the investigation during the next Congress. Expenses Committee.

S. 5624. Mr. McNary (Rep., Oreg.). This bill grants to the State of Oregon 1,000,000 acres of land heretofore reserved for national forests. The proceeds from the sale, lease, or other disposition of the land shall be used for the construction of public buildings at the state capital. Agriculture.

National Parks

H. R. 5729. This bill creates the Ouachita National Park in Arkansas, but protects existing mineral rights to the land. Reported by the Public Lands Committee.

IMPORTANT BILLS REVIEWED IN THIS ISSUE

Mining

H. R. 15919—Douglas (D., Ariz.). Mineral Land Patents. Passed by the House.
S. 5269—Norbeck (R., S. Dak.). Forest Mining Rights. Passed by Senate.
S. 1347—Oddie (R., Nev.). War Mineral Court Appeal. Enacted Into Law.
H. R. 496—Potash Investigations. Passed by the Senate.
S. 5691—Jones (R., Wash.). Mineral Fertilizer Loans.
H. R. 12520—Nez Perce Indian Mining Claims. Passed by the Senate.
H. R. 10157—Land Grant to Alaskan School of Mines. Enacted Into Law.
H. R. 15732—Land Grants for Miners Hospitals in Utah and Arizona. Passed by Senate.
S. 2366—Oil Leases on Osage Indian Lands in Oklahoma. Passed by the House.
H. R. 13484—Stream Pollution Inquiry. Enacted Into Law.
H. R. 17022—Hastings (D., Okla.). Lease of Oklahoma Indian Coal Lands.

Oil

S. Res. 320—Walsh (D., Mont.). Oil Contract Cancellation.

Lands

H. J. Res. 398—Northern Pacific Land Grants. Passed by House and Senate.
H. R. 13899—Land Titles in Michigan. Passed by Senate.
S. J. Res. 203—Steiwer (R., Ore.). Public Land Policy.

Revenue

S. 5399—Bruce (D., Md.). Tariff Commission Changes.
S. 5223—McKellar (D., Tenn.). Tax Refund Review. Reported by Committee.

Labor

H. R. 7729—Forbid Interstate Commerce in Goods of Convict Labor. Enacted Into Law.
H. R. 393—Wagner (D., N. Y.). Unemployment Census.

Industry

H. R. 17011—Larsen (D., Ga.). Anti-Trust Law Penalties.
H. J. Res. 414—Brand (D., Ga.). Currency Board Effect on Prices.
S. 5452—Alien Property Claim Extension. Passed by Senate.
H. J. Res. 365—World's Fair at Chicago in 1933. Passed by House and Senate.
H. R. 450—War Department Purchases of Military Supplies. Reported by Committee.

Immigration

H. R. 16927—Box (D., Tex.). Limitation on Visits of Aliens. Passed by the House.
H. R. 16926—Free (R., Calif.). Skilled Immigrants Preference. Passed by the House.

Power

H. R. 8305—Muscle Shoals Lease. Reported by Committee.
H. R. 15213—Power Leases on Indian Irrigation Projects. Passed by the House.

Transportation

S. 5582—Sheppard (D., Tex.). Steel Cars.
S. 5608—Reed (D., Mo.). Natural Gas Regulation.
H. R. 16697—Peavey (R., Wis.). Level of Great Lakes.
S. 4937—Black (D., Ala.). Radio Station Operation by Public Utilities.

S. J. Res. 206. This resolution authorizes the President to appoint a commission of five members to inspect the areas involved in the proposed adjustment of the boundaries of the Yellowstone National Park in Montana and Wyoming, reporting by January, 1931. Passed by the Senate and reported by the House Committee on Public Lands.

S. 3001. This bill authorizes a revision of the boundaries in the Yellowstone National Park, but provides that existing mineral rights shall not be effected. Passed by the Senate and reported by the House Committee on Public Lands.

S. 5014. This bill grants public lands to the city of Bozeman, Mont., but reserves the mineral rights to the Government. Passed by the Senate.

H. R. 310. This bill authorizes an addition to the Cache National Forest in Idaho, subject to existing valid entries. Reported by the Senate Public Lands Committee.

S. 5566. Mr. Pittman (Dem., Nev.). This bill adds certain lands in Lincoln, Nye and White Pine Counties, Nev., to the Nevada National Forest. Public Lands.

S. 5543. This bill establishes the Grand Teton National Park in Wyoming, but protects existing mineral rights to the land. Passed by the Senate and reported by the House Committee on Public Lands.

S. 3940. Mr. Bratton (Dem., N. Mex.). This bill grants 76,667 acres of land for the benefit of the Eastern New Mexico Normal School at Portales. Reported by the Public Lands Committee.

S. 5374. Mr. Larrazolo (Rep., N. Mex.) and H. R. 16281, Mr. Morrow (Dem., N. Mex.). These bills grant 2,000,000 acres of land to aid in the establishment of a military and industrial school in New Mexico. The bills appropriate $750,000. Public Lands.

S. 5399. Mr. Bruce (Dem., Md.). This bill amends the Tariff Commission Act by providing for 12 members of the commission for 12-year terms, the commissioners to divide themselves into divisions with one member in charge of each to pass on matters before the commission in order to overcome present delays in disposing of the work. It also provides for a public relations counsel to represent the public before the commission. The bill repeals the flexible provision of the tariff law and takes from the President the authority to change tariff duties. The bill proposes that the commission shall report proposed tariff changes to Congress and that Congress shall authorize such changes. The commission would have authority to recommend the transfer of articles between the free and dutiable lists and would also be unrestricted as to the amount of duty it may recommend. Finance.

S. 5223. This bill provides for review of tax refunds of more than $10,000 by the Board of Tax Appeals. Reported by the Judiciary Committee.

H. R. 7729. This bill forbids the shipment in interstate commerce of goods mined or manufactured by convict labor. It would not take effect until January 19, 1934. Enacted into law.

Unemployment Census

H. R. 393. Amendment to by Mr. Wagner (Dem., N. Y.). This amendment provides that in taking the census in 1930 the Census Bureau shall collect figures as to employment and unemployment.

S. 5614. Mr. Reed (Rep., Pa.). This bill creates the positions of Undersecretary and two Assistant Secretaries in the Department of Labor. Labor.

H. R. 17078. Mr. Howard (Dem., Okla.). This bill authorizes the establishment by the Interior Department of an employment agency for the Indian Service to procure employment for Indians. It appropriates $50,000. Indian Affairs.

H. R. 17011 and H. R. 17012. Mr. Larsen (Dem., Ga.). These bills provide for increased penalties for violation of the anti-trust laws. Instead of penalties of $5,000 as now provided, the bills would provide penalties of from $25,000 to $100,000. Judiciary.

H. J. Res. 414. Mr. Brand (Dem., Ga.). This resolution proposes an investigation by the Banking Committee of the House as to whether the policies of the Federal Reserve Board since 1925 have had the effect of decreasing commodity prices. Rules.

S. 5684. This bill proposes to terminate the War Finance Corporation on April 4. Passed by the Senate.

S. 5452. This bill extends until March 10, 1930, the time within which claims for the return of property may be filed with the Alien Property Custodian. Passed by the Senate and reported by the House Interstate Commerce Committee.

H. J. Res. 365. This resolution invites foreign countries to participate in a World's Fair in Chicago in 1933, which will show the advance of industries during the past century. Passed by the House and Senate.

H. R. 16793. Mr. Johnson (Rep., Wash.) This bill proposes to continue in the government service research specialists beyond their retirement age. Civil Service.

H. R. 11526. This bill authorizes the construction of 15 cruisers, including armor and armament, at a cost of not more than $17,000,000 each, and one aircraft carrier costing not more than $19,000,000. Enacted into law.

Military Supplies

H. R. 450. This bill authorizes the War Department to place orders of $1,000,000 each during the next five years for military supplies with private plants to educate them in government requirements for materials in war. Reported by the Military Committee.

H. J. Res. 395. Mr. Wainwright (Rep., N. Y.), and S. J. Res. 204. Mr. Reed (Rep., Pa.). These resolutions provide for a commission of four members of the House, four members of the Senate, the Secretaries of War, Navy, Agriculture, Commerce and Labor, and five civilians representing labor, industry, capital, agriculture and the professions to report next December proposed legislation to mobilize all the resources of the country during war. Rules and Military Committees.

H. R. 14156. This bill appropriates $125,000 for the construction of a cannon powder blending unit at the government arsenal at Dover, N. J. Passed by the House.

H. R. 5780. This bill provides for payment of additional compensation to employes of the Bethlehem Steel Company under naval contracts as granted by the National War Labor Board in 1918. Passed by the Senate.

H. R. 13825. This bill authorizes the construction of power plants and gas and oil storage systems at various army posts. Passed by the Senate.

H. R. 16503. Mr. James (Rep., Mich.). This bill authorizes the construction of power plants and oil and gas storage systems at various army posts. Military Affairs.

H. R. 16457. Mr. Box (Dem., Tex.). This bill authorizes the Orange Car and Steel Company, of Orange, Tex., to sue the Government for recovery under contracts during the war for the construction of ships. Claims.

H. J. Res. 391. Mr. Bulwinkle (Dem., N. C.). This resolution increases the membership of the House of Representatives from 435 to 480 members. Judiciary.

H. R. 11725. This bill reapportions the membership of the House on the basis of the last census. Under the measure the following state would gain Representatives: California, 6; Michigan, 4; Ohio, 3; New Jersey and Texas, 2 each; Arizona, Connecticut, Florida, North Carolina, Oklahoma and Washington, 1 each. The following states would lose Representatives: Missouri, 3; Indiana, Iowa, Kentucky and Mississippi, 2 each; Alabama, Kansas, Louisiana, Maine, Massachusetts, Nebraska, New York, North Dakota, Pennsylvania, Tennessee, Vermont and Virginia, 1 each. Passed by the House and reported by the Senate Committee.

S. J. Res. 205. Mr. Capper (Rep., Kans.). This resolution proposes a constitutional amendment, providing that aliens shall not (*Continued on page* 217)

PROGRESS *in* TREATING MINE TIMBERS

Joint report on timber preservation submitted by Timber Preservation Committees of the Coal and Metal Mining Branches of the American Mining Congress Standardization Division

THE last report by this committee was presented at the December, 1926, meeting of the American Mining Congress, but it was not published and received no wide circulation. Since that time material progress has been made in extending the use of treated wood by the mining industry. New plants have been put into operation at several mines, old plants have continued to produce treated timber, and the purchase of commercially treated timber and ties has increased. At least one of the producers of wood preservatives has placed a specialist in the field to promote the sale of its product and to be of service to the mining industry.

Treatment by Commercial Wood Preserving Plants

There are about 90 commercial wood preserving plants in the country using pressure processes. With few exceptions, these plants, until recent years, have given little attention to the mining industry and have not tried very hard to secure business in this field. Some companies have sought mine business, however, and have sold appreciable quantities of treated ties and mine timbers. The interest in the commercial treatment of mine material is increasing both among the mine operators and the wood preservers, and the business should show very material growth in the next few years.

The wood impregnating industry in the United States is a large, highly specialized industry, which has been developed for the main purpose of supplying preserved timber. The users of commercially treated wood for the most part are large industrial concerns, such as railway, telephone, telegraph, and power corporations, which are financially able to build and operate large-scale treating plants, but have decided that it is good business and more convenient or economical to take advantage of this specialized service. The commercial plants afford an opportunity for the mines to secure all the advantages of pressure treatment with a good preservative without the necessity of investing in expensive equipment and training men to operate it. Reliable commercial plants can be depended upon to do their work thoroughly, and they can furnish much better treatment than will be obtained if the mining company treats for itself in open tanks. Mines in remote regions may be able to secure the benefits of treated timber only by erecting plants and treating for themselves, but any mine within reach of a commercial treating plant can buy pressure-treated timber or have its own timber treated on contract.

Metal mines in the United States, on account of their being mostly situated in regions remote from commercial treating plants, have been chiefly dependent on their own treating plants, although a few of them have been able to take advantage of commercial treatment. Most coal mines, however, are more favorably situated in parts of the country where treating plants are available within practicable distances, hence coal mines are the principal users of commercially treated mine timber. In the coal mining districts of Pennsylvania, Indiana, and Illinois, a number of mine operators are regularly using mine ties treated with zinc chloride in commercial wood preserving plants. Others have purchased small orders from time to time. Several coal mines have also installed commercially creosoted ties in surface tracks and underground. With the expected revival of better business conditions in the coal mining industry, following the various adjustments now going on, a decided increase in use of treated timbers may be confidently expected.

In many of the leading mining districts mines are so situated that timbers can be routed from their point of origin through a commercial treating plant with little, if any, addition in transportation charges. Many railroads have a treating-in-transit rate that permits the stopping of shipments of timber at commercial plants for treatment without any increase in the through rate to the point of delivery.

Several of the commercial plants are equipped to frame timbers to the mine operator's specifications before treatment. In some mining districts treated timbers and ties can be obtained through various mine lumber dealers who sell framed, treated timbers and treated ties direct to mine operators, the timber dealer having the timber cut, seasoned, and then treated in a commercial plant before delivery to the mine operator. Several wood preserving plants have large tracts of standing timber, and supply treated timbers and ties to mine operators according to specifications of the purchaser; or treat on contract timbers supplied by the mine operators and mine timber dealers.

Lists of commercial wood preserving plants and data on standard specifications for pressure treatment can be obtained, on application, from the Service Bureau, American Wood Preservers' Association, 10 South La Salle Street, Chicago, Ill., and from the U. S. Forest Products Laboratory, Madison, Wis.

Treating Costs

The cost of treatment is a fixed charge against the timber, and will not vary greatly, regardless of which one of the business arrangements mentioned above is employed. The cost of treatment in commercial plants compares very favorably with the cost of operating a private plant, when a reasonable figure is allowed for all the important factors that enter into the cost of treatment, including a fair return on the investment. Legitimate charges include (1) cost of timber f. o. b. origin; (2) peeling or sawing; (3) seasoning; (4) freight; (5) handling; (6) preservative; (7) labor at treating plant; (8) fuel or power in operating plant; (9) delivery to mine; (10) interest, maintenance, and depreciation on investment in treating plant and equipment; and (11) operators' profit.

TYPICAL COSTS OF PRESSURE TREATMENT WITH COAL TAR CREOSOTE IN COMMERCIAL PLANTS

	6 lb. Rueping treatment 80-20 creosote-coal tar mixture.
Large timbers:	
Per 1000 bd. ft. (83.3 cu. ft.)	$20.00 — $28.00
Per cu. ft.	0.24 — 0.34
Per set of three timbers (12" dia. x 8') 250 bd. ft.	5.00 — 5.75
Small timbers:	
Per 1000 bd. ft.	18.00 — 26.00
Per cu. ft.	0.22 — 0.32
Per mine tie (6" x 8" x 6')	0.44 — 0.64

A specific example follows from actual cost reported by a coal mine operator in an eastern district:

SPECIFIC EXAMPLE OF COMMERCIAL CREOSOTED TIE COSTS

Tie, 6" x 8" x 6', f. o. b., origin	$0.63
Freight to treating plant	.12
Treatment (6 lb. Rueping 80-20 creosote-coal tar mixture)	.48
Freight to mine	.10
Tie iron	.02
Treated tie delivered	$1.35

TYPICAL COSTS OF PRESSURE TREATMENT WITH ZINC CHLORIDE IN COMMERCIAL PLANTS

	At ½ lb. per cu. ft.	At 1 lb. per cu. ft.
Large timbers:		
Per 1000 bd. ft. (83.3 cu. ft.)	$12.00-$18.00	$15.00-$20.00
Per cubic ft.	0.15- 0.22	0.18- 0.24
Per set of 3 timbers 12" in. dia. x 8' long (250 bd. ft.)	3.00- 4.50	3.75- 5.00
Small timbers:		
Per 1000 bd. ft.	10.00- 16.00	13.00- 18.00
Per cu. ft.	0.12- 0.18	0.15- 0.22
Per mine tie (6" x 8" x 5½')	0.22- 0.35	0.28- 0.40
Per mine tie (6" x 8" x 6')	0.25- 0.40	0.30- 0.40

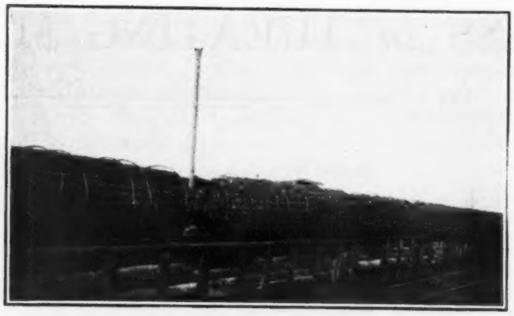

Fig. 1.—Red oak mine ties treated with zinc chloride, awaiting shipment from a commercial wood preserving plant. Ties are 5" x 6" x 6' and 6" x 7" x 6' in size.

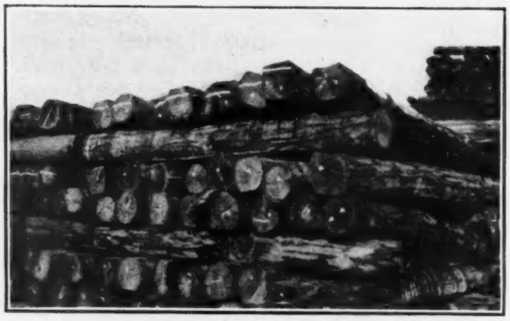

Fig. 2.—Green red oak mine ties stacked for air seasoning at a commercial wood preserving plant.

Fig. 3.—Zinc chloride treated logs installed October, 1926, in a coal mine near Terre Haute, Ind.

Fig. 4.—Part of the seasoning yard at the treating plant of the H. C. Frick Coke Co., Leckrone, Pa. Yard locomotive in foreground

The cost of treatment with zinc chloride at various commercial plants ranges from about $12 to $18 per 1,000 board feet for large timbers and lumber (15 to 22 cents per cubic foot) for treatment with one-half pound of zinc chloride per cubic foot, which has been standard for many years in timber for surface construction and railway crossties. The cost for treatment with an average retention of 1 pound per cubic foot is about $15 to $20 per 1,000 board feet (18 to 24 cents per cubic foot). For timbers used underground, the higher absorption is preferable on account of the greater fire resistance and greater protection against decay under conditions of maximum severity.

The following costs are reported by one coal mine operator for commercial treatment of 5 by 6 in. by 5½-ft. mine ties: Zinc chloride (½ lb. per cu. ft.), 13½ cents per tie; creosote, 6-pound Rueping with a mixture containing 80 percent creosote and 20 percent coal tar, 21 cents per tie.

Specific Installations of Commercially Treated Timber

In the anthracite region, where the Philadelphia and Reading Co., with its private pressure plant, has for 20 years been demonstrating the advantages of using treated timber, three other leading anthracite companies have in the past two years adopted the use of treated timber.

One of the principal obstacles to commercial treatment is that in many of the anthracite mines the great variations in height of working make it difficult to standardize on any few sizes of sets, with the result that some companies hesitate to order treated timber, knowing they must cut the legs to length at the mine after treatment. At least one company has adopted the policy of purchasing treated timber and sawing off legs where necessary, believing it can sacrifice a considerable part of the ultimate maximum life, rather than forego the benefits of using treated timber. It has calculated that an increased life of only a few years on treated material spoiled by cutting, if realized, would more than repay cost of treatment.

The Lehigh Coal and Navigation Company, after considerable experimental work with various preservatives in 1925 and 1926, is reported to have purchased in 1927, 1,500 sets treated with zinc chloride, and 1,500 sets treated with Ac-Zol.

The Weston Dodson Coal Company installed, in 1928, 56 sets of zinc chloride treated timber in its Pine Hill colliery. The treatment added about one-third to the cost of the timber delivered.

Chicago, Wilmington and Franklin Coal Co.—Since the destruction of its open tank creosoting plant at Orient, Ill., by fire in June, 1924, this company has been buying commercially treated timber to supply its treated timber needs. A number of other coal companies in the same bituminous region have also been

Fig. 5.—End of treating cylinder at Leckrone, Pa. The cylinder is 7 ft. in diameter and 27½ ft. long.

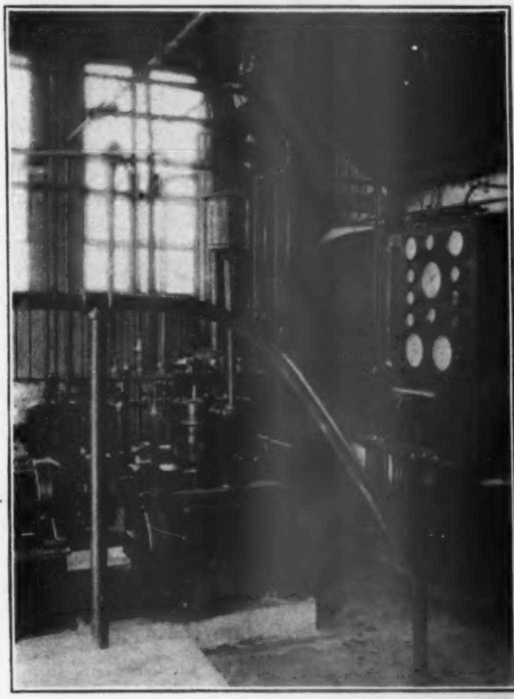

Fig. 6.—Operating room, gauge board and preservative weighing apparatus at the H. C. Frick Coke Co. timber treating plant, Leckrone, Pa.

Fig. 7.—Monorail system of loading treated material from treating trams to truck or railway car. H. C. Frick Coke Company, Leckrone, Pa.

buying commercially treated timber. Ordinarily these companies are buying creosoted ties for surface railway tracks and zinc chloride treated mine ties and timbers for underground use. Treatment with zinc chloride is said to add one-third or more to the cost of the timber delivered at the mines of this region, which is an economical investment on an annual cost basis.

The O'Gara Coal Company is reported to have installed several carloads of zinc chloride treated mine ties and creosoted mine ties in coal mines in Illinois in the past year. The ties are purchased from commercial wood preserving companies.

The Valier Coal Company is reported to have installed at Valier, Ill., zinc chloride treated mine ties purchased from a commercial treating plant in 1926, and to be using zinc chloride treated ties for all permanent installations, both surface trackage and underground. Some zinc chloride treated timbers have also been used in wooden mine doors.

The Butler Consolidated Coal Company, Wildwood, Pa., is installing a zinc chloride treated stairway in a new concrete air shaft. The timber is to be treated with 1 pound of zinc chloride as a protection against fire as well as rot.

The Saxon Coal Company in 1926 began using commercially treated ties and lagging in its coal mine near Terre Haute, Ind. The cost of untreated sawed mixed oak ties and sawed lagging is estimated at $32.75 per 1,000 bd. ft., delivered at the mine. The cost for zinc chloride treated material is approximately $50 per 1,000 bd. ft. The average life of untreated material is approximately three to five years, which is only about one-third to one-fourth of what may be expected from the treated timber.

The Temple Fuel Company, at Aguilar, Colo., is reported to have installed a shipment of creosoted timber at its Brodhead mine. The timber was framed before treatment and then creosoted by the Rueping empty cell process. It is too early yet to obtain useful service records.

The Colorado Fuel and Iron Company in 1927 installed 1,475 5 by 6 in. by 5 ft. lodgepole pine ties treated by the Rueping process with 5 pounds per cubic foot of a mixture of coal-tar creosote and petroleum. They are all marked with dating nails so they can be found and identified readily in the future. This company reports that red spruce (Douglas fir) mine ties, untreated, cost about 41⅛ cents each installed, and creosoted pine about 67½ cents. Since the treated ties can be expected to last several times as long as the untreated, the treated ones will prove much the cheaper in the long run.

Standardization of Mine Timber Sizes

One of the principal obstacles to advancing the use of commercially treated timbers and ties is the great variety of lengths and sizes used by different mining companies. The adoption of standard sizes for mine drift sets has permitted some mines to anticipate their needs for at least a year in advance. With respect to mine ties, there are so many different sizes in use that commercial treating plants can not profitably undertake to carry all sizes in stock, since they have no means of measuring the probable demand for each size.

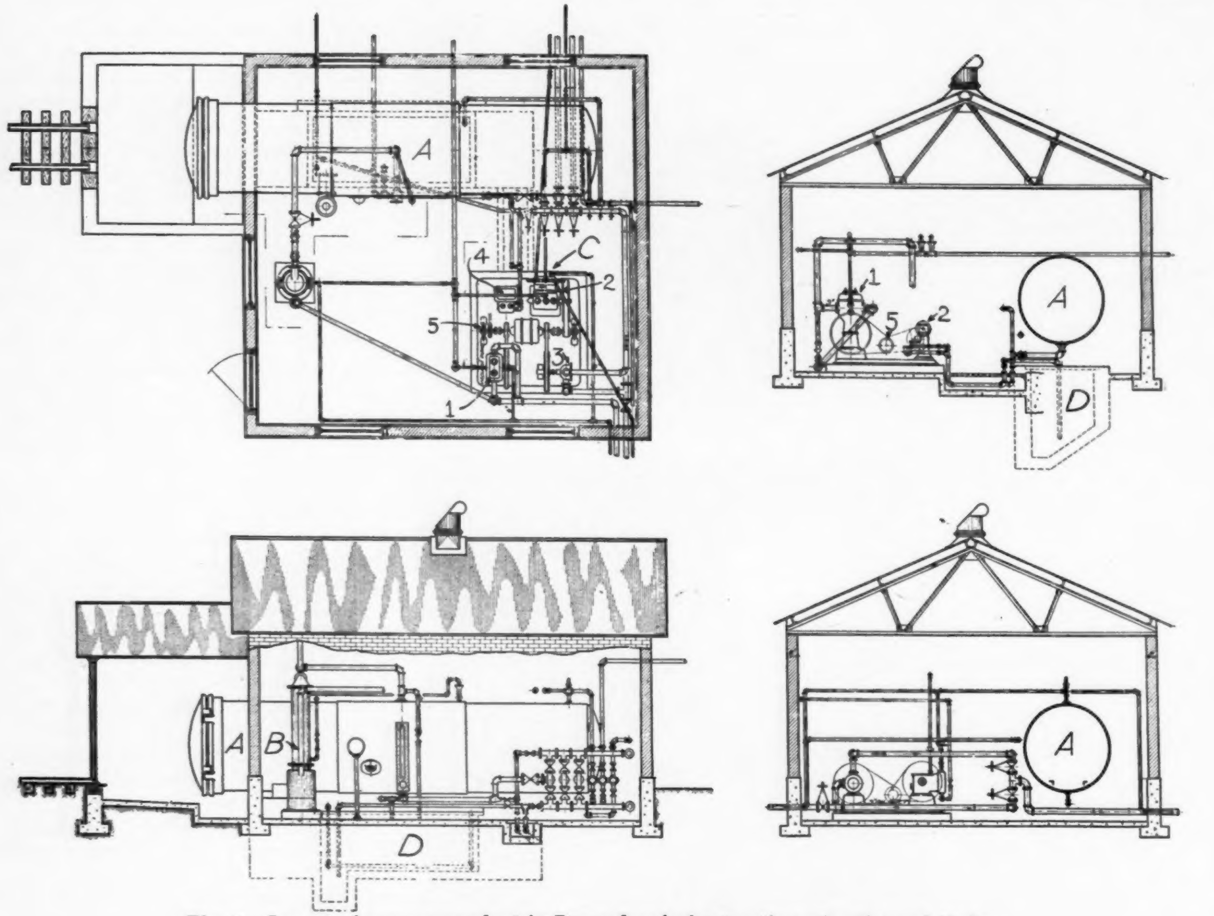

Fig. 8.—Layout of a pressure plant in Pennsylvania for treating mine ties and timbers. A, treating cylinder; B, condenser; C, power unit, which includes (1) vacuum pump, (2) air compressor, (3) general service pump, (4) pressure pump, (5) motor for power unit; D, underground measuring tank and pump.

If the number of sizes of ties that are to be treated could be reduced to three or four stock sizes that would fill all requirements for this class of treated material, the commercial plants would be enabled to stock such sizes and maintain a supply of treated ties at the plant ready for immediate shipment. The cost of manufacture of such material could, in the opinion of several leading wood preserving companies, be considerably reduced.

Privately Owned Treating Plants at Mines

H. C. Frick Coke Co.—During 1927 the H. C. Frick Coke Company installed and put into operation at Leckrone, Fayette County, Pa., a pressure plant with an estimated annual capacity, on a two-shift basis, of about 500,000 cu. ft. of timber. The plant serves a group of mines owned by the company in this neighborhood. Natural ground conditions were used to advantage in planning the unloading, loading, and storage of timber. The storage yard lies on a side hill paralleling the railroad supply track and a public road. Green timber is received on railroad cars and shifted to a track well up on the hillside. Unloading is then done by means of gravity roller conveyors to storage lower down. Seasoned timber is loaded by the same conveyor onto trams for treatment, the trams being placed lower down on the hillside. The trams are shifted about the yard and into the cylinder by a steam locomotive. Treated timber is loaded directly from the treating trams to railway cars or automobile trucks by means of a monorail hoist, for delivery to the mines.

The treating retort is 8 ft. in diameter and 27½ ft. long, and is designed to operate at pressures ranging up to 250 pounds per square inch, and temperatures up to more than 200° F. It will hold from four to five trams of ties or posts, and can treat approximately 250 to 300 ties or posts per charge. Superimposed above the treating retort is a second cylinder, which can be used in heating preservatives or when treating by the Rueping empty-cell process. This cylinder is 8 ft. in diameter and 22 ft. long and has a capacity of 13,000 gallons. The scale tank, beneath the treating retort, will weigh charges of preservative up to 18,900 pounds. The sump tank is 6 ft. in diameter by 28 ft. long. There are three vertical storage tanks, each 10 ft. in diameter by 24 ft. in height, with a capacity of over 14,000 gallons each; three air receivers, a condenser, air compressor with electric motor, vacuum pump with separate motor, and a general service pump.

The plant is provided with a fireproof building, the boiler plant being in a separate room. Between the boiler room and the main room is a room containing two mixing vats of wood construction with lead lining. These vats are approximately 3 ft. deep, 3 ft. wide, and 5 ft. long. In these vats the fused zinc chloride is reduced to approximately 50 percent solution, which is then transferred to the storage tanks and diluted to working strength, about 4½ percent.

The treating plant is equipped to treat with either oils or water soluble preservatives. The present practice is to treat material for surface use with coal-tar creosote, injecting about 6 pounds per cubic foot by the Reuping empty-cell process. All material going into the mines is treated to refusal with zinc

chloride solution by the full-cell process, injecting on the average the equivalent of 0.75 of a pound of the dry salt per cubic foot. The plant has not been operating long enough to give comparative records on the life of treated and untreated timber. From past experience with occasional lots of treated timber, however, the company expects a life of at least 15 years from the treated timber, while the average life of untreated timber in its mines has been about four years.

The Consolidated Lumber and Supply Company built a pressure plant at Indiana, Pa., in 1926, with a treating cylinder 63 in. in diameter and 24 ft. long, which can be operated at pressures ranging up to 225 pounds. The two storage tanks are 10 ft. in diameter by 22 ft. in height and have a capacity of approximately 12,800 gallons each. The plant serves about 30 to 40 mines in the vicinity. The accompanying photographs show an inside view of the operating room of the plant and a view in the tie-seasoning yard. The cost of the plant and yard layout was a little less than $25,000. The material awaiting treatment is stored and handled on the yard with great care in order to provide good seasoning conditions and to guard against decay during the seasoning period.

The principal species of wood treated are oak, maple, beech, ash, and birch, the larger percentage being mixed oaks. The preservative used is coal-tar creosote, which is injected under a pressure of about 200 pounds per square inch and at a temperature of 190° to 200° F. The absorption obtained varies from about 5½ to 6 pounds per cubic foot in ties, drift, and shaft timbers and lagging. During 1927, with the plant operating only part time, it treated over 36,000 mine ties and 94,500 ft. board measure of drift timber, shaft timber, and lagging.

Steam for the operation of the plant is obtained from a boiler plant, which is necessarily operated for other purposes, hence the cost of the wood preserving plant is low. Aside from the men handling the timber and loading trams, only one man is required for the operation of the plant.

The Inspiration Consolidated Copper Company, at Inspiration, Ariz., is installing during the present year a pressure plant for treating mine timbers and lagging. The plant will have a capacity of 160 to 250 cu. ft. per charge. It is stated that the preservative used will be zinc chloride. The amount of timber to be treated is estimated at 2,000 to 4,000 bd. ft. daily of sawed Douglas fir timbers and sawed lagging.

The United Verde Copper Company, Jerome, Ariz., is installing a pressure treating plant for treating its mine timbers with zinc chloride. The treating cylinder is 5 ft. 6 in. inside diameter by 32 ft. long, and has a capacity of 310 cu. ft. per charge. A mixing tank of 1,000 gallons capacity will be provided with steam coils, and the zinc chloride solution will be elevated from this tank to the 5,000-gallon storage tank by means of a 5¼ by 3¼ by 5 in. duplex pump. The vacuum will be supplied by an Ingersoll-Rand 10 by 5 in. (Imperial type 15) vertical double acting belt-driven unit. The retort is equipped with 2-in. pipe steam coils providing 180 sq. ft. of radiating surface. It will be filled by gravity from the storage tank, and pressure will be maintained by a small duplex pump equipped with a governor to maintain a constant pressure.

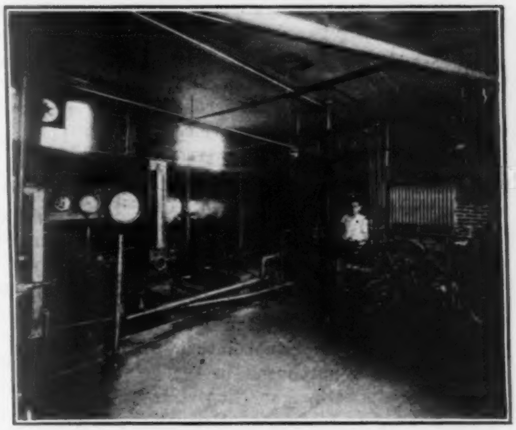

Fig. 9.—Operating room and treating cylinder at the mine timber treating plant of the Consolidated Lumber and Supply Co., Indiana, Pa. The treating cylinder is 63 in. by 24 ft. in size and treats ties and timber for a large number of mines in the vicinity.

Fig. 10.—Mine ties seasoning for treatment. Consolidated Lumber and Supply Company, Indiana, Pa.

Fig. 11.—Comparison of treated and untreated timber after 4 years' service in the Primero mine of the Colorado Fuel and Iron Company, Primero, Colo. The untreated timber (at left) is decayed at the bottom while the treated timber beside it is sound.

The Miami Copper Company built a small pressure treating plant at Miami, Ariz., and commenced to operate it in June, 1925. An illustrated description of the plant was presented in the 1925 report of this committee. Mr. J. H. Hensley, Jr., mine superintendent, makes the following report of the activities during 1927. The results obtained from the treated timber thus far will be found later in this report.

"Our timber treating operations for the year 1927 were as follows:

Timber treated, bd. ft.		1,452,363
Zinc chloride used, lb.		77,431
Zinc chloride used, lbs. per cu. ft.		0.63977
	Cost	Cost Per M
Direct labor	$3,805.13	$2.61996
Zinc chloride	4,817.26	3.31684
Maintenance	1,349.33	0.92906
Total	$9,971.72	$6.86586

"The above costs do not include any charges for air, steam, vacuum, water or depreciation of plant."

The Cleveland Cliffs Iron Mining Company has remodeled the open-tank treat-

ing plant at its Athens mine, Negaunee, Mich., by adding two open-tank treating vats of concrete, 8 ft. deep, 20 ft. long, and 14 ft. wide at the top. Each vat holds about 40 average size round timbers per charge. Both vats are equipped with steam coils and with removable covers to reduce evaporation and heat losses during treatment. The original plant was described in the 1924 report of this committee (Fifth Standardization Bulletin, 1926, pages 112 to 118). The steel treating tanks of the original plant are now used as mixing tanks for preparing the zinc chloride solution. The zinc chloride is purchased in the solid form and reduced to a solution strength of about 4 1/5 to 5 percent. Borings are taken every day to observe the penetration of preservative. It averages about 1 in. in the sapwood of maple and birch round timbers, but sometimes goes as high as 1½ in. The penetration in the heartwood at the ends and in the framing is usually slight. The plant can now treat two or three times as much timber in a day as formerly, using but three men, which is one less than before.

Colorado Fuel and Iron Company.—The open-tank treating plant of this company at Primero, Colo., was described in the 1926 report of this committee. An illustrated description was also published in the MINING CONGRESS JOURNAL, July, 1926. The plant used coal-tar creosote chiefly, but made some experimental treatments with Ac-Zol. The good results obtained with both treatments, after four years service, were described in the 1926 report of this committee. When the mine was closed in 1928 the treated timber was still good and observations of the timber were to be continued for a year. The practice of putting dating nails in all classes of timber as it is installed has been followed for the past few years and is of great value in studying the service obtained. The experiments at Primero, over a five-year period, have proven conclusively to the company the value of treating timber and ties for all entries or places having a life of five years or more. The company is also convinced that it pays to treat all lagging to be used with treated timber. Untreated lagging often permits the roof to fall, leaving the treated timbers standing in the falls.

Since its installation in 1922 the Primero plant has treated, by the open-tank process, 52,353 cu. ft. of timber, at a reported cost of 10.8 cents per cubic foot, or $9.05 per 1,000 ft. board measure.

The Moctezuma Copper Company (Phelps Dodge interests) is treating mine timbers with zinc chloride in an open-tank plant installed in 1926 at Nacozari, Mexico. The timbers treated are said to be western yellow pine. It is reported that about 10,000 cu. ft. of timbers are treated yearly.

The Mexican Corporation, Inc., is installing an open-tank plant at its metal mines near Fresnillo, Nacatecas, Mexico, for treatment with zinc chloride.

SERVICE RECORDS

Coal-Tar Creosote

Records are numerous on the life of ties and timber treated with coal-tar creosote and used above or below ground, and it is not necessary to repeat old records here. The following records of service or of new experiments with creosoted timber have not been reported before:

The Chicago, Wilmington and Franklin Coal Company creosoted 600 hewn oak ties, 5 by 5 in. by 6 ft. in size, at its Orient, Ill., open-tank plant, and laid them in 1,200 ft. of main haulage track underground in its Orient No. 1 mine in 1923. During December, 1927, heavier steel was laid on these ties in place of the original. It was found during the operation that all of the ties were sound and serviceable except eight that had been damaged by wrecks or by respiking. *These ties have already given two years more service than the average life of similar ties untreated, and they will no doubt serve four or five times as long.*

The Linton Coal Company reports that creosoted white oak timbers in its mine at Linton, Ind., are still sound after eight years' service. Untreated timber in the same place has a life of about two years.

Zinc Chloride

The use of zinc chloride above and below ground has been extensive, and numerous records of the service given have been published. The following records have not hitherto been presented:

The Miami Copper Company, of Miami, Ariz., reports as follows concerning the pressure-treated timber in its mine:

"A rather detailed report of our service records for zinc treated timber to date follows:

"The first zinc chloride treated timber sent underground was placed in the N 1150 E 540 W drift on the 720 level, in June, 1925. Since then 2,300,000 bd. ft. of Douglas fir and Texas pine have been treated and placed in the various drifts and raises of the mine. Of this amount all is in good condition, showing no rot, with the exception of one cap and one post of 6 by 6 in. Douglas fir in the N 1050 E 250 N drift on the 360 level; one round Texas pine post in the N 885 E 202 E drift on the 820 level; and one 8 by 8 in. Douglas fir post in the N 600 E 202 N drift on the 690 level.

"The post and cap on the 360 level were found to be partly decayed four months after they were placed, which was in August, 1925. The post on the 820 level was found to be rotten about two months after it was placed. The surrounding timber on both the 360 and 820 levels was sound, and has remained so. Hence, it seems reasonable to suppose that these pieces of timber were rotten before they were treated and that the operator did not notice the fact.

"The post on the 690 level was in good condition, except that for a distance of about 2 in. on each side of a wound about a foot long, an inch deep, and an inch wide, at the bottom of the post. This wound had been made by tearing out a large sliver, probably by blasting. As the average depth zinc chloride solution penetrates Douglas fir sawed stock is half an inch, this post could be considered untreated in the part now decaying.

"In 1925, during the months of May, June, and July, 33 treated Douglas fir sets, 11 untreated Douglas fir sets, and 36 Port Orford cedar sets were placed in the N 1,000 E 540 N and the N 1,150 E 540 W drifts on the 720 level. The treated sets are all sound. Five of the untreated Douglas fir posts, 22 cedar posts, and 10 cedar caps show signs of decay. The decaying cedar sets are mostly in the E 540 drift. Of the 19 cedar sets in the N 1,150 drift, only one post shows decay. The atmospheric conditions at the time the timber in these two drifts were placed were identical. However, as development has progressed, the air in the E 540 drift has become more humid, and that in the N 1,150 drift dryer. This difference in humidity is undoubtedly the cause of the cedar in the E 540 drift failing so much more rapidly than that in the N 1,150. This contention is borne out by the fact that the timber is rotting at the top of the drift, where the air is the most humid, faster than at the bottom, and also by the fact that farther south in the same drift where the air is dryer cedar posts older than those farther north are sound.

"On the 420 level, in the N 1,218 E 250 E drift, 44 sets of round Texas pine posts and 6 by 6 in. Douglas fir caps were placed in June and July, 1927. Some sets were treated and some were not, there being about the same number of each. Within a month the untreated posts had a heavy coating of fungus over their upper portions, which were kept moist by the outgoing humid air. The treated posts and the caps were unaffected. When this drift was holed and dry No. 3 air forced through, the fungus dried up, and except for a slight punkiness the infected posts seem in good condition.

"In 1925, on the 690 level, in the N 600 E 202 drift, 21 untreated Douglas fir sets were placed in October, 31 treated Douglas fir sets in November, and 16 Port Orford cedar sets in December. Of the untreated Douglas fir sets, three posts show decay, two to a considerable amount. The Port Orford cedar and the treated timber is all in good condition, with the exception of the treated post already mentioned. The air in this drift is good, and it will probably be several years before any real comparison can be made between the respective lengths of life of Port Orford cedar and the treated and untreated Douglas fir.

"On the 1,000 level, however, a different condition exists. There the air is very humid, the ground moist, and the temperature above normal. Under these conditions timber rots very quickly, and comparisons can more easily be made. All of the treated timber is in good condition. Of the 58 Port Orford cedar sets, all placed since December 1, 1925, 44 posts and 2 caps are decayed, 1 post being quite rotten. No untreated Douglas fir sets were placed in this drift, but the blocking, the braces at the bottom of the posts to the ties, and the ties were un-

treated Douglas fir. These are all badly decayed.

"In August, 1926, 8 by 8 in. untreated Douglas fir stringers were placed as braces between the posts north of No. 5 shaft on the 1,000 level. The posts are treated Douglas fir, and were placed in January and February of the same year. The posts are all in good condition, but the untreated stringers, wherever they are in contact with moist earth, are badly decayed.

"It is thus seen that under conditions such as exist on the 1,000 level, untreated Douglas fir has a life of about one year; that Port Orford cedar shows appreciable decay in two years; and that zinc chloride treated Douglas fir, being as yet undamaged by decay, will have a much longer life than either of the other two woods.

"The treated timber, both Douglas fir and Texas pine, is universally in a state of good preservation, and it is impossible at present to estimate its probable life."

The Vandalia Coal Company in 1922 installed in its mine at Dugger, Ind., about 350 mine ties and posts pressure treated with ½ pound of zinc chloride per cubic foot. In 1928, after six years' service, the mine management reported that all of the treated material was sound, whereas the average life of untreated material was three to six years. Hence, the advantage of treatment has been demonstrated in this period.

The Taylor Coal Company has demonstrated the superiority of treated material in its mine at Herrin, Ill., where about 1,300 mine ties pressure treated at a commercial plant, installed in 1922, were sound when inspected in 1927, whereas untreated material has a short life. The treated ties were manufactured by sawing in two at the mine full-size railroad ties, which were treated before delivery. Sawing after treatment undoubtedly exposed untreated wood at the center of the ties, and the maximum life of the treated material will probably be less, therefore, than would normally be expected.

The Cambria Coal Company, in November, 1926, installed in its Meadowbrook mine at Zeising, W. Va., several hundred mixed oak sawed ties pressure treated with ½ pound zinc chloride per cubic foot. At the same date several hundred untreated hewed ties were installed for comparison. In July, 1928, 10 of a group of 200 untreated ties were showing fungus growth and incipient decay, whereas 200 treated ties inspected were all perfectly sound. Therefore, even in this short period, 19 months of service, the treated ties have demonstrated their superiority. The average life of untreated ties in this mine is estimated at four to six years. The treated ties should last considerably longer.

The treated ties obtained from a commercial wood preserving plant in Indiana are 4 by 6 in. by 5½ ft. mixed hardwoods. The cost is reported as 75 cents each, delivered at the mine, as compared to untreated, hewed ties obtained locally at 30 cents delivered. The treated ties, however, are a higher grade, and of more uniform quality, hence the above figures includes both a difference in quality and a difference in freight costs.

Clinton District.—The average life of untreated surface tracks at coal mines in the Clinton, Ind., district is not more than six years at the most. The Ferguson Coal Company in 1922 laid 5,000 crossties treated by the Card process, with ½ pound zinc chloride and 2 pounds of creosote per cubic foot, in surface tracks at its mine near Clinton. The treated ties in 1928 were still all sound, whereas untreated ties would have had to be replaced in this period.

Deep Vein Coal Company.—One of the earliest installations of zinc chloride treated timber underground in the Illinois and Indiana fields was in the Deep Vein Coal Company (Ebbw Vale) No. 4 mine at West Terre Haute, Ind., where a carload of oak crossbars treated with ½ pound of zinc chloride per cubic foot at a commercial wood preserving plant was installed in 1912. In 1922, when the workings were abandoned, a number of the treated crossbars were recovered. The average life of untreated crossbars was stated as one year. The recovered bars were placed in the No. 5 mine, and in 1926, after 14 years service, were reported to be still sound and apparently good for many additional years. This is one of the most convincing demonstrations of the increased service rendered by treated material over untreated.

Ac-Zol

The Colorado Fuel and Iron Company, at its Primero mine, soaked timbers in Ac-Zol solution and placed them underground in 1922 along with several sets of untreated timber. In 1926 the treated sets were taken from their original location and reset in the main entry. The untreated timbers were so decayed that they were not worth moving, but all but three sets of the treated timber were sound, and it was found that the treated sets which showed decay had been trimmed off after treatment.

New experiments with Ac-Zol treated timbers were started in 1928 by the Colorado Fuel and Iron Company at Berwind, Colo.

At the United Verde Extension mine, Jerome, Ariz., experiments were started in 1922 with Douglas fir timbers soaked in Ac-Zol solution for different periods of time up to 96 hours. At last report, in March, 1928, the treated timbers were practically all sound after four to six years service, while a high percentage of the untreated timbers placed at the same time were either badly decayed or removed for decay. Timbers which had been soaked in Ac-Zol and placed in 1922, 1923, and 1924 were practically all still sound in March, 1928, but a few of the treated timbers were showing decay after four to six years of service. The fungus attack on timbers that had been treated appeared to be chiefly due to injury or bruising of the timber after treatment. On treated lagging placed on the 800-ft. level behind concrete sets in 1922, a few lagging were showing decay after six years service, the untreated lagging was largely decayed and part had been replaced.

On the 1,100-ft. level one or two treated posts are showing decay. Shaft timbers that were treated and placed in 1924 were said to be still sound, but some untreated station posts had been replaced in three years on account of decay.

Several experimental installations of Ac-Zol treated timber in various other coal mines have been reported.

Arsenic

The Anaconda Copper Mining Company, having large quantities of arsenic as a by-product, has undertaken to determine its value and suitability as a mine timber preservative. Its pressure treating plant at Rocker, Mont., is now treating with arsenic solution only. The following statement by Dr. H. C. Gardiner, of the Anaconda Copper Mining Company, tells of the experiments which have been made or are under way:

"Localities in eight different mines in Butte were selected in which experimental treated timbers could be placed. Places were chosen which would, first, likely be open to inspection for a number of years, and, secondly, in which timbers were known from past experiences to decay very rapidly. One hundred thirty-two pieces (44 mine sets) round timber, having a cubical content of approximately 6 cu. ft. per piece, were treated with solutions of both sodium arsenite and arsenious acid by the full-cell process and placed in these various localities. No difficulties were met in securing the net retention desired even in quantities of over 1 pound of dry salt per cubic foot. These experimental installations have been in place over two years. Results so far obtained have come up to full expectations.

"In addition to these pressure treated mine sets, 86 mine sets (258 pieces), with a total cubical content of about 1,540 cu. ft. of wood, mostly seasoned pine, were treated during the summer of 1926 in a small open tank plant at the Leonard mine. These timbers were put into place in various localities in the Leonard and East Colusa mines, during the summer and early fall of 1926. A solution of sodium arsenite worked out in our laboratories, which has a comparatively low alkalinity, was used in the treatment. Uniformly good depths of penetration and net retention of solution were secured. In this same plant during the winter of 1926 and up until April 1, 1927, 21,890 cu. ft. of square framed Douglas fir timber to be used in an air raise in the Tramway mine were treated with this same low alkalinity sodium arsenite

solution. In this most difficult wood to treat an average depth of penetration of about 3/16 in. was secured with a net retention of about 3/10 pounds of the dry salt per cubic foot of wood.

"In January, 1927, the company started to use the low alkalinity sodium arsenite solution in its pressure treating plant at Rocker, Mont. Since this plant has been operating on this solution, approximately one and one-half million cubic feet of square sawed Douglas fir mine timber, planking, and pole stubs have been treated."

Wolman Salts

It is known that a number of installations of timber treated with Wolman salts have been made in mines during the past several years, but the committee has thus far been unable to secure information on the present condition of the timber from the mining companies using it.

New Publications

The Carnegie Institute of Technology has recently published a 300-page bulletin (No. 33) on "Methods and Costs of Treating Mine Timber: What to Treat and What Life to Expect," which was prepared by Mr. L. D. Tracy, coal mining engineer of the U. S. Bureau of Mines, and Mr. N. A. Tolch, research fellow, Carnegie Institute of Technology. The bulletin goes into the subject very exhaustively and gives much information of value to anyone interested in the subject of mine timber preservation. The practices followed and results obtained at various mines are discussed in detail. The bulletin also contains a bibliography which lists most of the literature of importance bearing on the subject. Copies may be purchased from the Carnegie Institute of Technology, Pittsburgh, Pa., at $2 each.

Bureau of Mines Bulletin 235, "Mine Timber, Its Selection, Storage, Treatment and Use," by R. R. Hornor, H. E. Tufft, and G. M. Hunt, was published in 1925. It contains much useful information directly applicable to the timber problems of a mine operator. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 30 cents, cash or money order. (Stamps and personal checks not accepted.)

Statistics on Wood Preservation

The U. S. Forest Service, through the American Wood Preservers' Association, issues a statistical report each year showing the amount of timber treated with different preservatives for different purposes, the quantities of preservatives used, range of prices paid for the principal preservatives, location, number and ownership of the wood preserving plants of the country, etc. The total quantity reported treated in 1927 was over 345,000,000 cu. ft. The largest quantity reported previously was 289,000,000, in 1926. Over 244,000,000 gallons of creosote, creosote-petroleum and creosote-tar mixtures and over 22,000,000 pounds of zinc chloride were used in 1927, in addition to 631,000 gallons of miscellaneous preservatives.

A total of 5,824,717 bd. ft. of mine timber was reported as treated.

Copies of the report may be obtained free from the U. S. Forest Service, Washington, D. C.; the Service Bureau, American Wood Preservers' Association, 10 South La Salle Street, Chicago, Ill.; or the Forest Products Laboratory, Madison, Wis.

Conclusions

It has been established beyond the shadow of a doubt that proper preservative treatment is very effective in preventing decay under all conditions above or below ground where untreated timber decays. The mass of evidence available from a great variety of sources is completely convincing. The economy of using treated timber in places favorable to decay but where long life is desired has also been thoroughly established by the experience of many mining companies as well as by railroads and other users. Preservatives, properly applied and intelligently used, save both timber and money. Every mining company using timber in considerable quantities and spending money for replacing decayed timber in permanent openings should take advantage of the opportunity for operating economies offered by the use of treated timber, both above and below ground.

No one can say which of the several preservatives that may be used will give to timber *the longest life per dollar invested.* The question will probably never be answered completely. Good results can be expected of coal-tar creosote, zinc chloride, and sodium fluoride, as well as from some proprietary preservatives that have been tried. It is poor policy to delay the use of preservatives until the best has been found and adopted as the standard for the industry. It is also illogical to await the results of one's own experiments with various preservatives before adopting a general treating policy. By the time the first experiments are completed new preservatives will be suggested, new experiments must be started to give them a trial, and the process may be repeated indefinitely. In the meantime the timber and money that might have been saved by using any one of a half dozen preservatives are being wasted.

The logical procedure is to adopt some preservative which is economically available and which has shown itself to be effective, and to use it as extensively as practicable, either in a company plant or through commercial wood preserving plants. Experiments can be started at the same time and added to year by year if desired, in order to search for possible improvements in preservative or treating practice, but in the meantime the savings resulting from the extensive use of a preservative will be accruing.

The committee urgently recommends that all mining companies give favorable consideration to the use of preservatives for wood above and below ground, and that they profit by the experience of the growing list of companies which have adopted the use of treated timber as standard practice.

The foregoing report is submitted as information by the joint Subcommittees on Preservation of Mine Timbers, whose membership is as follows:

Coal Mining Branch
Committee on Mine Timber

Warren R. Roberts, Chairman

Subcommittee No. 2, *Preservation of Mine Timbers:*

Geo. M. Hunt (*Chairman*), U. S. Forest Products Laboratory, Madison, Wis.; R. L. Adams, chief engineer, Old Ben Coal Corpn., Christopher, Ill.; W. L. Affelder, assistant to president, Hillman Coal & Coke Co., 2306 First National Bank Bldg., Pittsburgh, Pa.; R. W. Austin, Austin & Wood, North Third Street, Clearfield, Pa.; M. E. Haworth, chief engineer, Hillman Coal & Coke Co., First National Bank Bldg.; Pittsburgh, Pa.; J. A. Helson, superintendent of treating plant, Joyce-Watkins Co., Metropolis, Ill.; J. C. Quade, chief engineer, Saline County Coal Corpn., Harrisburg, Ill.; M. H. Sellers, timber agent, Chicago, Wilmington & Franklin Coal Co., Carbondale, Ill.; D. A. Stout, chief engineer of mines, Colorado Fuel & Iron Co., Pueblo, Colo.; H. E. Tufft, Grasselli Chemical Co., Cleveland, Ohio.

Metal Mining Branch
Committee on Mine Timber

Frank H. Probert, Chairman

Subcommittee No. 1, *Preservation of Mine Timbers:*

Geo. M. Hunt (*Chairman*), U. S. Forest Products Laboratory, Madison, Wis.; Dr. H. C. Gardiner, care Anaconda Copper Mfg. Co., Anaconda, Mont.; J. H. Hensley, mine superintendent, Miami Copper Co., Miami, Ariz.; J. L. Hyde, Mine Timber Dept., Cleveland Cliffs Iron Co., Ishpeming, Mich.; C. N. Kerr, Service Bureau, American Wood Preservers' Association, 10 South La Salle Street, Chicago, Ill.; Gerald Sherman, consulting mining engineer, Phelps Dodge Corpn., P. O. Box 1158, Douglas, Ariz.; H. E. Tufft, Grasselli Chemical Co., Cleveland, Ohio.

LEGISLATIVE REVIEW

(From page 208)

be included in the count of population under which members of the House are chosen. Judiciary.

IMMIGRATION MEASURES

S. 5447. Mr. Metcalf (Rep., R. I.). This bill proposes to give preference to skilled labor in the admission of aliens under the quota restriction law. Immigration.

H. R. 16927. Mr. Box (Dem., Tex.). This bill provides that after July 1, 1929, no alien shall be considered as visiting the United States temporarily if he comes to this country to seek employment. Passed by the House.

H. R. 16926. Mr. Free (Rep., Calif.). This bill proposes that after July 1, 1929, preference shall be given to 50 percent of aliens entering the country under the restriction law to those who are skilled in a particular business or science. Passed by the House.

H. J. Res. 402. Mr. Chindblom (Rep., Ill.). This bill extends until July 1, 1930, the time of taking effect of the national origin provision of the immigration law. Immigration.

A similar bill was rejected in the Senate Immigration Committee by a vote of 4 to 7.

H. R. 8305. This bill proposes the lease of the Muscle Shoals, Alabama, nitrate and power project to the American Cyanamid Company and the Air Nitrates Corporation. At one session of the Military Committee the bill was rejected, but at a later session it was reported.

S. 5375. Mr. McMaster (Rep., S. Dak.). This bill authorizes a survey of the Missouri River in South Dakota for the purpose of selecting a dam for generating electric power for the manufacture of by-products from agricultural products. Commerce.

H. R. 15213. This bill authorizes 10-year leases by the Interior Department for power development on Indian irrigation projects. Passed by the House.

S. 4710. Mr. Phipps (Rep., Colo.). This bill authorizes the sale under 25-year contracts of surplus power developed under the Grand Valley reclamation project in Colorado. Passed by the Senate.

H. R. 14674. Mr. Taylor (Dem., Colo.). This is similar to the foregoing. Reported by the House Irrigation Committee.

S. J. Res. 201. This resolution forbids the Federal Power Commission from issuing permits or licenses affecting the Colorado River or tributaries except the Gila River and tributaries. Passed by the Senate.

H. J. Res. 388. Mr. Taylor (Dem., Colo.) This is similar to the foregoing. Interstate Commerce.

S. 3770. This bill authorizes the Federal Power Commission to issue permits and licenses on the Fort Apache and White Mountain Indian Reservations in Arizona. Passed by the Senate and reported by the House Indian Committee.

TRANSPORTATION BILLS

H. R. 16841. Mr. Garber (Rep., Okla.). This bill provides that the Interstate Commerce Commission shall divide itself into divisions of one or more members and shall hold meetings once a year in four places in each rate group. Interstate Commerce.

H. R. 16883. Mr. Summers (Rep., Wash.). This bill authorizes the Interstate Commerce Commission to assign to individual commissioners or to boards of employes of the commission certain classes of matters for action. Interstate Commerce.

S. 5718. Mr. Fess (Rep., Ohio). This is similar to the foregoing. Interstate Commerce.

S. 5582. Mr. Sheppard (Dem., Tex.). This bill provides that railroads shall use steel or steel underframe cars in the passenger train service. Interstate Commerce.

S. 5412. Mr. Copeland (Dem., N. Y.). This bill extends sections 204 and 209 of the transportation act to coastwise water carriers. Interstate Commerce.

S. 5608. Mr. Reed (Dem., Mo.). This bill proposes to subject the transportation of natural gas to the jurisdiction of the Interstate Commerce Commission. Judiciary.

H. R. 16697. Mr. Feavey (Rep., Wis.). This bill proposes to maintain the level of the Great Lakes by forbidding the diversion of water therefrom except under regulation of the War Department. Rivers and Harbors.

H. J. Res. 396. Mr. Denison (Rep., Ill.). This resolution proposes an investigation by the War Department at a cost of $150,000 as to the desirability of constructing the Nicaraguan Canal. Interstate Commerce.

S. J. Res. 117. Amendment to by Mr. Hawes (Dem., Mo.). This amendment provides for an investigation by three army engineers and two civilian engineers as to the desirability of constructing the Nicaraguan Canal.

S. 4937. Amendment to by Mr. Black (Dem., Ala.). This amendment provides that permits for operation of radio stations shall not be granted to public utility corporations.

H. R. 16570. Mr. Vestal (Rep., Ind.). This bill provides for the regulation of the ownership of inventions of government employes and the control and administration of government-owned patents. The President would be authorized to sell or license such patents. Patents.

THE CRACKING OF COAL TARS

(From page 204)

with 5 lb. of 60° Bé. sulphuric acid per barrel, drawing off the acid sludge after settling. There should be no water at this stage of the procedure.

(5) Agitate with an additional 5 lb. of 66° Bé. sulphuric acid. The acid sludge is allowed to settle and is then drawn off.

(6) Thoroughly wash the oil with water, preferably by the shower method.

(7) Neutralize the acid compounds left in the oil by the addition of 3 percent by volume of a 16° Bé. sodium hydroxide solution. The sludge is allowed to settle and is drawn off.

(8) Subject the chemically treated pressure distillate oil to steam and fire distillation, at a relatively low temperature, approximately 135° C.

(9) Wash with 8° Bé. sodium hydroxide solution to give a finished motor fuel.

Application of the above treatment to a sample of distillate produced a motor fuel of plus 25 color Saybolt, stable to sunlight for 3 days. It was negative to the doctor and corrosion tests and contained 10 mg. of gum per 100 c. c. There was no trace of tar acids or bases present in the finished gasoline. The sulphur content of the motor fuel was 0.43 percent.

FRACTIONAL DISTILLATION OF CRUDE PETROLEUM

Recent investigations have indicated that crude petroleum is much more complex in nature than has been supposed, says the United States Bureau of Mines. The average crude oil is made up of possibly several hundred individual substances. Owing to a lack of published information on the application of correct scientific and engineering principles to the distillation of crude petroleum much refining apparatus has been designed and built that is not well adapted for the purpose intended.

In order to obtain fundamental data in the fractionation of petroleum, the Bureau of Mines, some time ago, constructed at the Petroleum Experiment Station, Bartlesville, Okla., an experimental pipe still and bubble-tower apparatus. The tower was designed by M. B. Cooke, senior author of Technical Paper 431, just published, which gives the results of studies conducted by the bureau with the aid of this apparatus.

Copies of Bureau of Mines Technical Paper 431, "Studies in the Fractional Distillation of Crude Petroleum," by M. B. Cooke and H. P. Rue, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 15 cents.

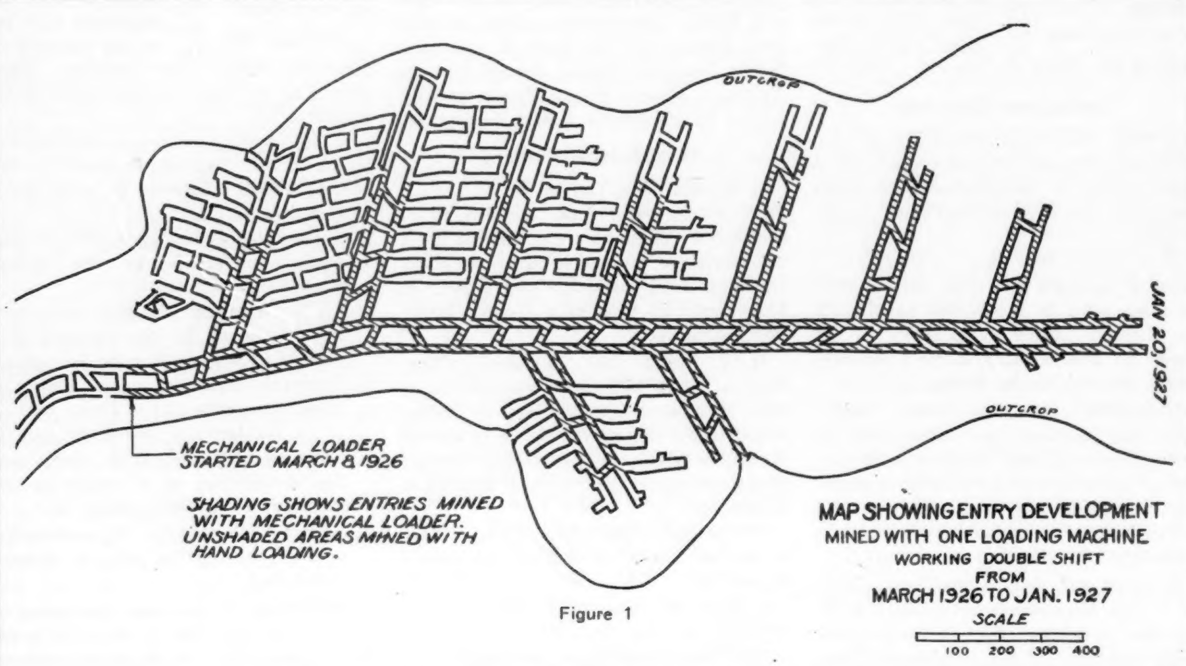

Figure 1

MECHANIZATION REPORT NO. 94

By G. B. Southward

MECHANIZATION Report No. 94 describes the progress which has been made in the last three years by a coal company which has been operating loading machines in several of their mines. The first machine was installed in the early part of 1926 after a study of the methods used at other mines had convinced the officials of this company that mechanical loading was practicable. The results of the first year's operation fully justified the expectations and in the summer of 1927 a second machine was installed. Both machines have operated continuously and have been employed largely for driving entries in development work although they have also been used to some extent in advancing rooms and pulling pillars. A third machine is now on order.

The first installation in March, 1926, was made in a mine where it was desired to speed up the entry development in order to provide additional working places for an increased tonnage, and the map in Figure 1 shows the amount of entries which were driven during this first year. This was done by one loading machine working for the most part on double shift, and amounted to a total advancement of slightly over 10,000 linear feet of narrow work including entries and breakthroughs. In this mine the mechanical loader was confined

MECHANICAL LOADERS IN ENTRIES, ROOMS AND PILLARS

entirely to development work and the rooms were driven with hand loading. The machine tonnage, together with the additional hand working territory thus provided, increased the mine output from 200 to 900 tons per day. It will be noticed from the map that the coal boundary is a long narrow outcrop area and the entry development was necessarily confined to one pair of main headings with short room entries.

In February, 1927, the loading machine was transferred to another mine which was just being opened, shown in Figure 2. This mine was to be worked on the room and pillar system and it was decided to eliminate hand work and use mechanical loading in the entries, rooms and pillars. The development proceeded rapidly and in August, 1927, after the rooms had been started a second mechanical loader was installed. The map in Figure 2 shows the territory mined from February, 1927, to August, 1928, at which time most of the rooms had been driven up and the pillar recovery had made considerable progress. Shortly after this one loading machine was taken out of the mine and moved to a new operation; the second machine has continued on the pillar work which was supplemented to some extent by hand loading. The pillar recovery made after August, 1928, is not shown on this map but by the end of January, 1929, practically all of the coal had been mined out and only a few stumps remained.

In December, 1928, a new operation shown in Figure 3 was started. This mine is projected for mechanical loaders in the room and pillar system and according to the present plans the rooms and pillars will be worked retreating. The map in Figure 3 shows the amount of development which has been done from the time the machine started on December 7, 1928, until January 31, 1929. In this territory the main entries have been advanced a distance of 500 ft. from the overcast which is a short distance inside the drift mouth and two pairs of room entries have been driven an aggregate distance of 400 ft. Including the breakthroughs, the total amount of narrow work driven during this six weeks period is approximately 1,600 linear ft. This was all done with one loading machine working partly on double time and the production record shows that there was a total of 52 loading shifts operated during this period to make this development. This figures an average advancement of 30 linear ft. of narrow work per shift.

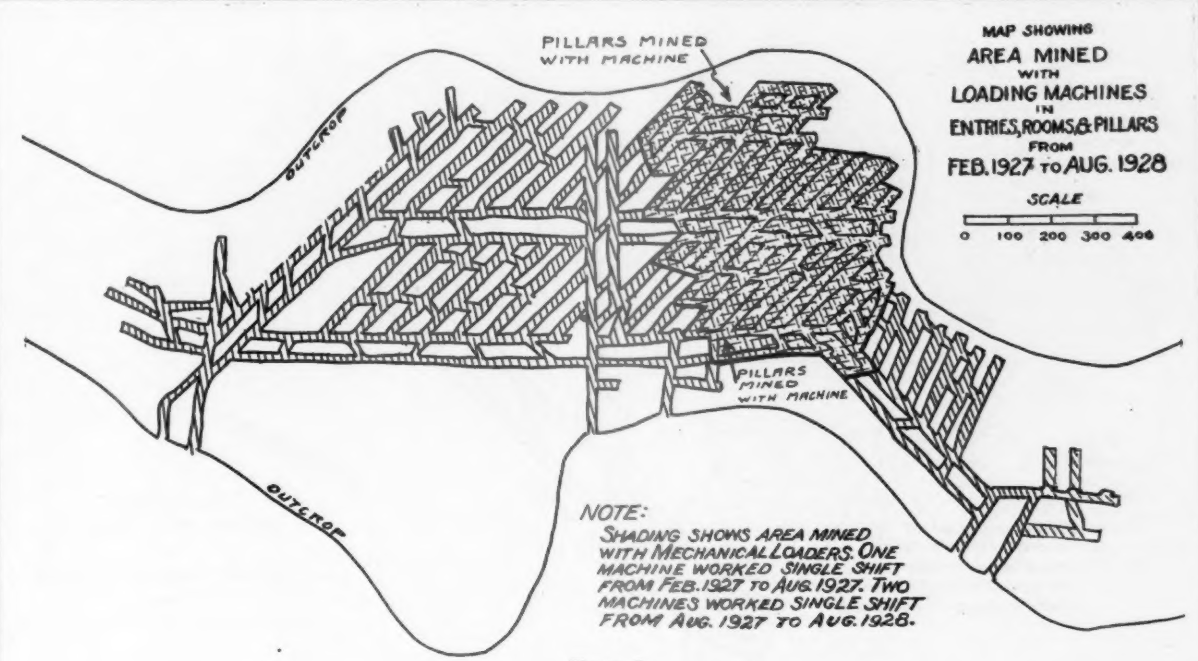

Figure 2

Production Records

In the mine shown in Figure 2, during the period from August, 1927, to August, 1928, the two loading machines worked 240 days and loaded a total of 79,289 tons. This amounts to an average of 165 tons per machine per shift. In this operation the machines did not produce their maximum capacity as the daily tonnage from the mine was limited by the outside coal handling facilities.

The tonnages in the table below give the production mined with one loading machine operation during the months of December, 1928, and January, 1929, at the mine shown in Figure 3. The figures show that the average daily tonnage has increased from 76 tons per shift during the first three weeks of the operation in December to 183 tons per shift during the last half of January, 1929. The management expects to maintain an average machine shift production of 200 tons per day or an average daily tonnage on double shift of 400 tons from this operation and the indications are that this production is practicable and will be attained.

TONNAGE PRODUCED AT MINE SHOWN IN FIGURE 3

	Shifts	Tons
Dec. 7 to 31, 1928	18	1,365
Jan. 1 to 15, 1929	11	1,430
Jan. 16, 1929	1	178
Jan. 17, 1929	2	331
Jan. 21, 1929	2	481
Jan. 22, 1929	2	393
Jan. 23, 1929	2	345
Jan. 24, 1929	2	316
Jan. 25, 1929	2	432
Jan. 26, 1929	2	295
Jan. 28, 1929	2	341
Jan. 16 to 28	17	3,112

Summary

	Shifts	Tons	Av. tons per shift
December, 1928	18	1,365	76
Jan. 1 to 15, 1929	11	1,430	130
Jan. 16 to 28, 1929	17	3,112	183

In the three operations shown in Figures 1, 2, and 3 it will be noticed that the mining territory in each case consists of long narrow areas of coal bounded by the outcrop. In a situation of this kind the development work is necessarily confined to driving in one direction and the mine production is correspondingly limited to the rate at which working places can be developed by one or two sets of advancing entries. This means that the problem of providing mining territory is much more difficult than in a large boundary of coal where the development can be driven in several directions. Since the mining rate with mechanical loading has proved to be much faster than with hand loading, the use of loading machines in these properties has enabled the management to mine a production from these restricted areas equal to that usually had from hand operations with a greater development over a comparatively large territory.

The use of mechanical loading has been found to result in both direct and indirect savings. In the actual loading into mine cars there was a very material increase in the tonnage produced per man employed as compared with the tonnages obtained in hand loading. This saving of labor was offset to some extent by the cost of the supplies furnished by the company and by the interest and depreciation on the equipment but there was still a margin of profit in favor of the machine loading which could be figured in dollars and cents. The indirect savings were due to the faster rate of development with the machines and the increased tonnage which was made possible. In about one year's time the tonnage at this mine where one loading machine was used for entry development was increased from 200 to 900 tons per day. The exact value of this increased tonnage is difficult to reduce to a dollars and cents basis.

OPERATING REPORT

Figure 3

Physical Conditions

The seam has an average height of nearly 10 ft. with a parting 3 ft. above the bottom of the seam that usually runs about 6 in. thick. The coal has a hard, blocky structure. The top is a sandstone which does not require timbering in the entries and allows fairly large areas to be mined before a fall occurs. The bottom is a hard slate. The seam lies about level and the cover varies from 75 to 100 ft.

Mining System

The mine will be worked on the room and pillar system and the present plan contemplates working the rooms and pillars retreating after the entries have been driven to the outcrop. On account

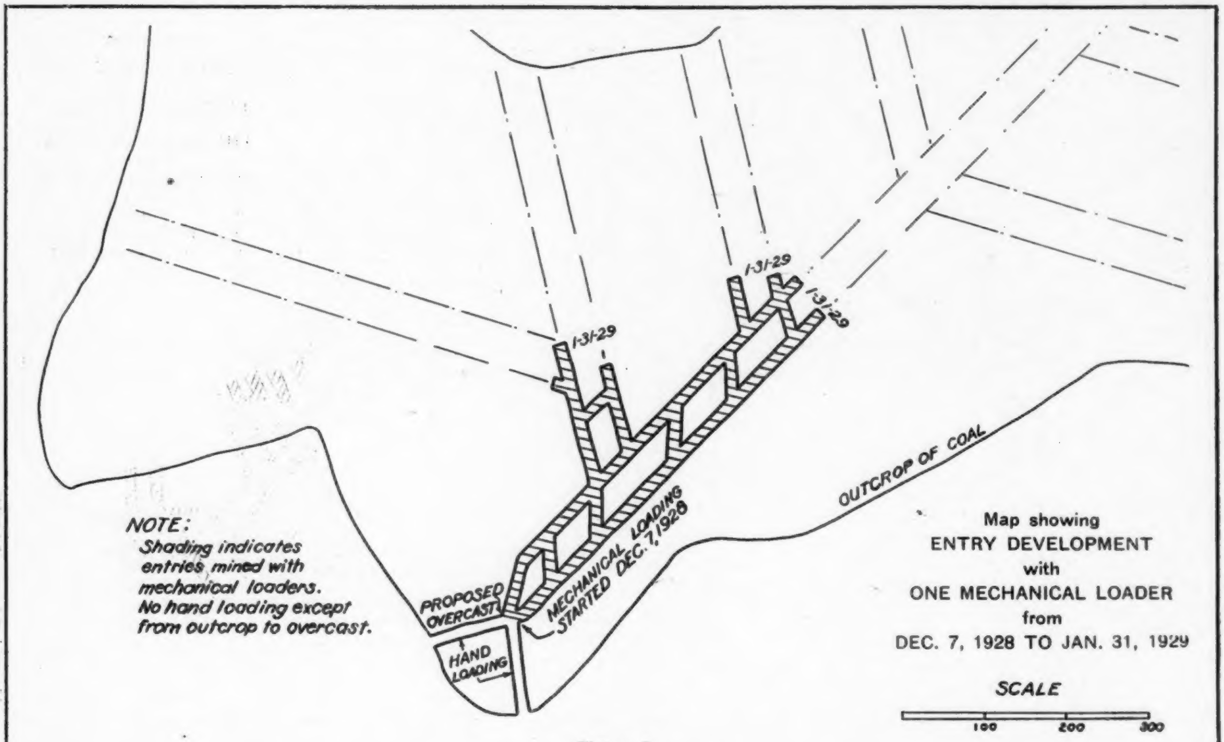

Figure 3

of the irregularity of the mining area no standard panel length is possible. The dimensions used in the previous operations are similar to those used in hand mining and will be followed in the new operation. The rooms are 200 ft. long turned on 50-ft. centers and are driven 18 ft. wide. In advancing room work a 6-ft. slab is mined along one room rib after the rooms have been driven. This increases the width about 24 ft. or approximately one-half of the pillar on the first mining. In the retreating system it is planned to drive the rooms 18 ft. wide and recover the entire pillar by successive slab cuts as soon as the room has been driven up. In the entry work the headings are driven from 12 to 14 ft. wide on 50-ft. centers with breakthroughs usually turned at an angle of about 60 degrees.

Mechanical Operation

A unit operation consists of cutting, drilling, shooting, loading, gathering and track work, and an operating unit has one loading machine, one cutting machine, one gathering locomotive and one electric hand drill. A unit operating crew consists of nine men; one foreman, one machine operator, two machine helpers, two cutting machine men who also drill the holes and fire the shots, two men on the gathering locomotive and one track and timberman. The work is done on two shifts of eight hours each and all the operations are performed continuously during the shift.

At the present time there are six entries advancing as shown in Figure 3 and the average number of faces loaded out during the shift varies from five to six cuts. The loading may be distributed over all the development taking one cut from each place during the day or it may be concentrated into one or two pairs of entries. When this is done more than one cut is loaded from a heading during a shift. In the main entries during December and January the average advance per shift was 10 linear ft. in each entry. This does not include breakthroughs but is the actual progress of the mine development.

The loading machine works entirely from the track and discharges into mine cars of three ton capacity. A gathering locomotive serves the machine and shifts out single cars as loaded. Track laid through the breakthroughs as shown in Figure 4 provides storage room for the gathering trips. This track is laid with 30 pound rail on 42-in. gauge.

The coal is cut by machine with a 7-ft. bar cutting about in the center of the seam. Six shots are used in an entry, three in the top and three in the bottom and a total of 27 sticks is used for one entry cut. The coal is well broken up by the shooting but the two machine helpers break down any hanging coal so that practically no picking is required by the loading machine. Some slate picking is done inside the mine but picking tables are used on the tipple. No screening is done and there is no attempt made to secure a high proportion of lump coal.

The methods as described in this operating report apply specifically to the mine shown in Figure 3 but they also apply in a general way to the operations as previously carried on in the mines shown in Figures 1 and 2.

Note—All turnouts to be standard No. 2 frogs with 12-ft. lead and 21-ft. radius.

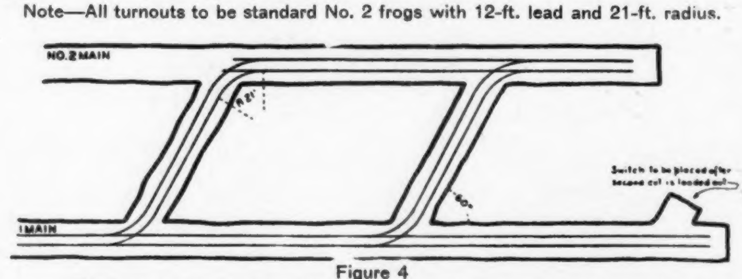

Figure 4
Track arrangement for entry development with mechanical loaders.

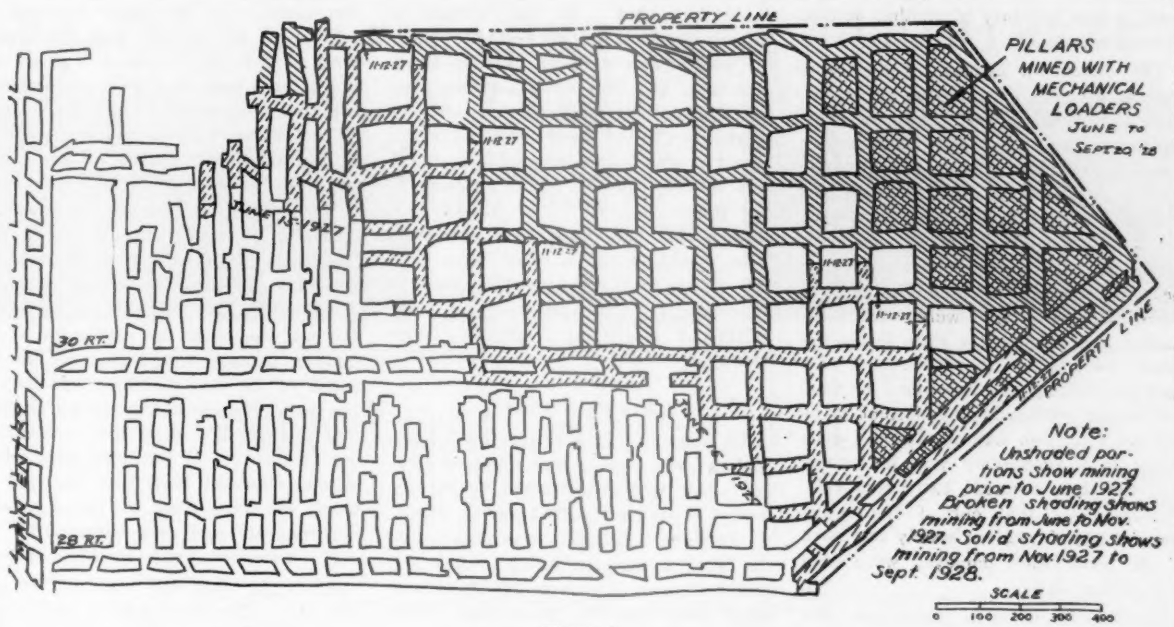

Figure 1
Map showing area mined
with mechanical loaders in entries, rooms and pillars,
during 1927 and 1928.

MECHANIZATION REPORT NO. 95

By G. B. SOUTHWARD.

MECHANICAL LOADING IN ENTRIES, ROOMS AND PILLARS

Supplementing Report No. 310.

MECHANIZATION Report No. 95 describes the progress made with mechanical loading in the mine covered by our previous mechanization Report No. 310. The first report described the operation as it was being carried on during the early part of the year 1927, and the present report is submitted to show what has been accomplished since that time until the end of the year 1928.

The mining in the panel described here was discontinued in the latter part of 1928, due primarily to unfavorable seam conditions, but a report on this operation is of value for two particular reasons. In the first place it shows an interesting change in the mining system from the room and pillar method to a block retreating system using mechanical loaders for the pillar recovery. The second point of interest is that the mechanical loading was operated under extremely severe mining conditions in which a slate parting near the center of the seam reached an average thickness of 17 inches.

The map in Figure 1 covers a section of this mine which was worked with mechanical loaders during 1927 and 1928. The unshaded operations show the mining with loading machines in the standard room and pillar system, prior to June, 1927. This operation was described in our Mechanization Report No. 310, and the machines were used to advance the entries and drive the rooms. No pillars were recovered with mechanized loading at that time.

In June, 1927, the mining method was changed to a block system as illustrated by the shaded areas of the map in Figure 1. All mining was done with mechanical loaders, the rooms were worked advancing and in one year's time—June, 1928—these had been driven to the panel limit and the pillars were started retreating. By the end of September, 1928, the pillar recovery had reached the point as indicated on the map.

During this period the mechanical loading operation was considered successful by the management of this company. The entry and room advancement completed the development of this panel in a comparatively short time and the recovery of the blocks with mechanical loading made favorable progress over the area indicated by the map. Two loading machines working on single shift during 15 months, from June, 1927, to September, 1928, mined the shaded areas shown on the map and over a period of 205 working days loaded an average of 416 tons per day.

In September, 1928, severe roof troubles were encountered. The top which had been fairly good in this panel seemed to undergo a change and it became very difficult to hold the roof in the rooms. This may have been due to a natural condition or it may have been the result of strains or crushing in the roof strata caused by the pillar recovery. To complicate the difficulties further the slate parting which normally had a thickness of from 4 to 8 inches increased to an average thickness of 17 inches. This proportion of slate in a 6-ft. seam of coal was almost prohibitive for mining, but the management reports that with mechanical loading the results obtained in the heavy slate areas compared very favorably with the hand loading in other sections of the mine where the parting was normal. However, the combination of the severe roof conditions and the heavy slate was such that the mechanical loading in this panel was discontinued when the mining had reached the point shown on the map and

the machines were transferred to developing a new territory in another section of the property.

The difficulties caused by the thick parting are well brought out by considering the proportion of men in the loading crew that were required either directly or indirectly to handle the slate. As will be shown in detail later in th s report a total of 31 men were employed for all of the mining operations from cutting at the working face to gathering locomotive delivery at the main line sidetrack. Of these, eight were used in removing and gobbing the slate inside the mine. In addition there were six men used for drilling and shooting. As four men would ordinarily be sufficient to do this work for two loading machine operations it is reasonably safe to assume that the slate required two extra men. This indicates that out of the entire crew of 31, 10 men or nearly one-third of the total labor employed were used in handling slate.

The amount of labor which the slate involved is well illustrated by the fact that the height of the gob reached practically to the roof. To stow this amount of slate with the loading machines would have necessitated considerable movement of the machine on its caterpillar mounting and the management considered that this operation would not be efficient or successful. It had been the intention to work out a method of handling slate mechanically but the proposed plan was prevented by the unfavorable roof conditions which were encountered.

The average production with mechanical loading during 205 working d showed a daily tonnage of 446 tons, or an average production per man per shift of 14½ tons. This production in the 17-inch parting is reported to compare favorably with the tonnage produced per man by hand loading sections where the slate had an average thickness of four to eight inches. Eliminating the men required for slate handling, the average tonnage indicated for the men employed on the machine operations for the actual coal loaded was approximately 20 tons per man shift.

It should be emphasized that the operation of the loading machine in this panel until September, 1928, was considered successful by the mine management. The discontinuance of the work was primarily and directly the result of adverse natural conditions and the management expects to continue mining with mechanical loading in a more favorable territory.

Operating Report

Physical Conditions

The seam has about 6 ft. of hard structure coal with a bone parting in the center which normally varies from 4 to 8 inches. In the section of the mine covered by this report the parting has increased to an average thickness of 17 in. The top is a strong slate which usually stands well in rooms and entries, but in the panel described in this report it was found impossible to maintain the roof in the rooms adjacent to the pillar recovery. As already explained this may have been a natural local condition or it may have been caused by roof weight. The seam is approximately level; the cover at times reaches a height of 1,000 ft. Open lights are used.

Mining System

In Report No. 310 the mechanical loaders were used in the standard room and pillar system as shown by the unshaded areas on No. 28 entry in Figure 1. In June, 1927, this was changed to the block system in which rooms and cross cuts were driven at 116 ft. centers which developed the panel into blocks of coal approximately 100 ft. square. This is shown by the shading in No. 30 entry in Figure 1. In the block system the rooms were worked advancing and the pillar work was started retreating after the rooms nad been driven up. In the pillar recovery the blocks were usually mined by open end slabbing—taking cuts along one or two sides of the block until only a small stump about 10 ft. square was left. This was either recovered by hand or left unmined and a high percentage of extraction is reported.

All work in the panel on the entries, rooms, and pillars was done with mechanical loading—using two macnines, both working on single shift. As shown on the map in Figure 1 the development of the rooms and crosscuts in this panel was driven from two pairs of entries—Nos. 28 and 30. Consequently there was a sufficient territory for both machines to work during the same shift without interference. The mining was concentrated into a relatively small area and about 12 working places were usually under development for the two machine operations.

The loading was done on the nigh shift and each loading operation was worked as a separate unit with one mechanical loader and one gathering locomotive. The preparatory work such as cutting, drilling, slate handling, etc., was done on the day shift and one day crew prepared the places for both loading machines. This crew used one arc wall cutting machine and two electric drills.

The loading machines operated on caterpillars and discharged directly into mine cars of 2½-ton capacity. These were placed one at a time by a gathering locomotive. On the pillar recovery six cars were set at one time. A single track of 25-lb. steel on 48-inch gauge was laid in each room and cross cut and during the pillar recovery the tracks were shifted forward after each cut so as to be at the proper loading distance from the working face.

The cutting was made in the bone parting by a machine with a 9 ft. bar. This was an arc wall type that worked from the mine track. The cut was taken in the bottom of the parting and after the cut was made the remainder of the parting usually separated from the top bench of the coal and dropped down in the kerf. The bar of the cutting machine was then used to drag the broken slate out of the kerf to the mine floor where it was shoveled back into the gob by hand. At times when the parting would not separate and drop down from the coal it was necessary to drill and shoot it.

After the slate was removed the coal was shot. The seam was of hard structure and required strong shooting—at times as many as 10 holes were necessary in a room to bring down the slate parting and break the coal. The mechanical loader had considerable digging ability so that it could load out the coal when shattered in a standing face. The removal of the slate parting inside th mine cleaned the coal to a large extent, but additional slate pickers were used on the tipple. The management reports that the coal from the mechanical loaders did not require any more picking on the tipple than the coal loaded by hand and that the screened sizes from mechanical loading also compared favorably with that produced from the hand loaded section of the mine.

Operating Crew For Two Loading Machines

Day Preparatory Crew

Foreman	1
Cutting machine man	1
Cutting machine helper	1
Motorman for hauling supplies	1
Trackmen	2
Drillers	4
Dummy maker	1
Shot firer	1
Slate men	8
Mechanic	1
Total day preparation crew	21

Night Loading Crew

Loading machine operators	2
Loading machine helpers	2
Motormen	2
Brakemen	2
Tracklayers and clean-up men	2
Total night loading crew	10
Total day and night crews	31

Note: These crews during a period of 205 working days produced an average of 446 tons per day.

PRACTICAL OPERATING MEN'S DEPARTMENT

COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

WHEN COAL MINES *are* DUSTY*

By DAN HARRINGTON †

Two ounces of coal dust to linear foot of entry will propogate explosion—Mine of 1000 tons daily capacity produces 10 to 30 tons of fine dust — Few bituminous or lignite mines are not "dusty," should be rock dusted except where definitely wet, use closed lights, permissible equipment and explosives

THE title of this paper, strictly interpreted, refers to all coal mines; moreover, the term "dusty" applies to the presence of dust not only as an explosion hazard but as a health hazard as well. Notwithstanding the fact that there is good reason for the belief that under some circumstances (only too frequently present in coal mines) air dustiness constitutes a decided health hazard; nevertheless it is going to be assumed that the object desired in the preparation of a paper on this subject was to bring out information in connection with the explosion hazard, hence only the explosion feature will be considered. Thus any considerable reference to anthracite mines or mining is automatically eliminated from the discussion, since it has been found both by experience in mines and by tests that dusts of coal with less than about 10 percent volatile matter (which includes most of the anthracites) do not explode or do not in general aid in the propagation of an explosion. Hence this paper narrows to a discussion of the explosion hazards in dusty mines where coals have more than about 10 percent volatile combustible matter; these coals include bituminous, semibituminous, subbituminous, and various types of lignite coals.

The Bureau of Mines in its extensive testing work in connection with coal-dust explosibility (see Bulletins 167 and 268, Technical Paper 84, and other Bureau of Mines publications) has designated, and to a very large extent used as "coal dust," material which passes through a 20-mesh sieve, and it has been found that the explosibility is proportionate to the percentages passing through sieves of finer mesh, especially 100 and 200 mesh sizes. It is recognized that rarely, if at all, will coal dust consisting only of approximately 20-mesh size ignite and start an explosion, yet there is very good reason to believe that when an explosion has obtained a good start from gas or from fine or practically pulverized dust or from both gas and fine dust, coal particles appreciably larger than 20-mesh size participate in the extension of the explosion. And there is absolutely no question that finely divided (material with large percentage through 100 or 200 mesh), fairly dry coal dust which has volatile combustible above 10 percent will, when in air in a dense cloud and brought in contact with an open flame, ignite and burn with explosive violence. Moreover, tests by various governmental agencies, such as the Bureau of Mines in the Department of Commerce and the Bureau of Chemistry, Department of Agriculture, as well as field experience in industrial work, prove conclusively that many finely divided dusts besides those of coal will when subjected to flame of sufficient intensity ignite with explosive violence such dusts, for example, as starch, grain (wheat, oats, rye, etc.), oil shale, sugar, cocoa,

Handling coal by conveyors and loaders stirs much dust into the air and the health and safety of the mine workers around this equipment would be much safeguarded if water were used on the coal before handling and on the machines while working

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† Chief Engineer, Safety Division, U. S. Bureau of Mines.

aluminum, magnesium, sulphur, and even dusts of certain sulphide ores in metal mines. Generally any open light is sufficient for ignition, though in some instances an intensely hot flame is necessary.

To explode, coal dust must be mixed with air in a comparatively dense cloud. The coal dust-air mixture when in contact with an open flame ignites with practically simultaneous explosiveness in proportion to the volatile combustible matter in the coal as well as in proportion to coal fineness, dryness and freedom from impurities such as ash or similar incombustible, external moisture, etc. Although there must be a dense dust cloud at the point of ignition, there need not be any considerable quantity of dust by weight or volume to bring about a dust ignition and explosion.

By experiment it has been found that a dust cloud of comparatively pure, fairly high-volatile, finely divided bituminous coal in the amount of one-fortieth of an ounce of coal dust per cubic foot of air is about the least dense coal-dust cloud which will propagate or extend an explosion; this is less than 2 ounces of coal dust to the linear foot of ordinary coal-mine entry. There are few if any coal-mine entries, rooms, or pillar workings in which there is not present several times this amount of dust.

From one-sixth to one-eighth of an ounce of finely divided, fairly high-volatile, pure bituminous coal dust when in a uniform cloud in one cubic foot of air will explode violently and with high pressures when in contact with an ordinary open light or an electric arc. As applied to an ordinary mine entry having a cross section 5 by 12 feet this would be equivalent to 7½ to 10 ounces of dust per linear foot of entry.

In its coal-dust explosion work, the bureau has found that 1 pound of finely divided pure coal dust per linear foot of entry with a cross section of 5½ or 6 by 10 or 12 feet has been ample to propagate or extend explosions with extreme violence; this statement applies to any pure coal except anthracite and to atmospheres wholly without explosive gas.

A large amount of dust sampling has been done in rooms and entries as well as in pillaring and other regions in coal mines and quantities of dust passing 20-mesh have usually been found in the amount of several pounds per linear foot of entry; the road dusts generally have at least 15 to 20 percent of the dust passing 20 mesh which will go through 200 mesh—a decidedly explosive size. No adequate method has yet been devised to obtain accurate samples of settled dusts on ribs, roof, and timbers as these extremely finely divided, hence extremely explosive, dusts usually escape to a large extent with the air currents while sampling is being done. However, a sufficient amount of this very dangerous settled dust has been obtained to establish beyond question its extreme fineness and its presence in such quantities that few if any mines which are at all dry, or in which there are any dry portions, are free of danger from initiation and propagation of explosions by this dust on ribs, roof and timbers; this is wholly irrespective of the large amounts of dust usually found on the floor. The dust on ribs, roof, and timbers is usually the most dangerous not only because of its extreme fineness (it is frequently more than 75 percent through 200 mesh) but also because anything which dislodges this dust tends immediately to mix it intimately with the air to form the dust-air cloud which is necessary before dust can be exploded even when in contact with an open flame.

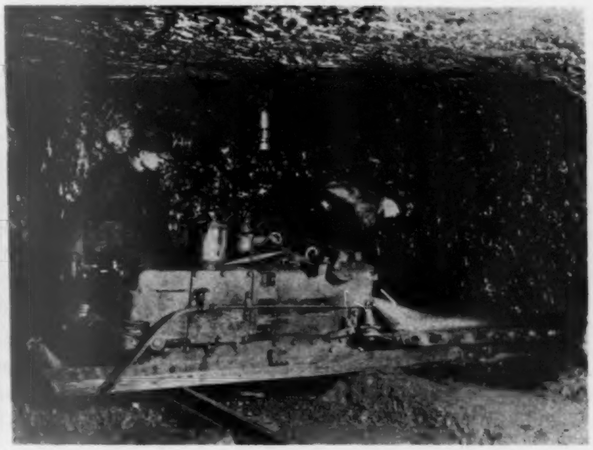
The danger from the much coarser but larger quantity of dust usually found on the floor of mine workings comes from the fact that the coarse material is crushed into fine dust by the fact of men and animals or by mechanical equipment such as pit cars, mining machines, loading machines, etc., and is thrown into the air by the various underground operations; later on the fine dust settles on larger particles or surfaces on the floor as well as on ribs, roof, and timber, and hence is quickly available to be thrown into the air as a dangerous dust cloud when disturbed by any unusual occurrence such as a fall of roof or coal, or a wreck, or a concussion from blasting. Moreover, when an explosion is well started the floor dust, even including some of the coarse material such as 20-mesh size or larger, enters actively into aiding the extension of the flame and violence. Hence coal dustiness is dangerous whether on the floor or on the ribs, roof, or timbers; even the fact that the floor may be wet to the extent of being covered by water does not prevent the propagation or the initiation of an explosion from finely divided dust on ribs, roof, and timbers, nor will the absence of coal dust from ribs, roof, or timbers prevent initiation or propagation of an explosion by fine, dry coal dust on the floor.

An expert in coal sizing, cleaning, and washing has stated that in coal fields of the Rocky Mountains more than 3 percent of the coal dumped from pit cars is material which will go through 48 mesh, hence would readily enter into a mine explosion; the same authority states that the amount of material passing 48 mesh as dumped from pit cars in one of the most productive bituminous coal seams in the eastern part of the United States is about 1 percent of the load; therefore, it is apparant that ordinary mining processes in mines of 1,000 tons' capacity per day produce daily 10 to 30 tons of material sufficiently fine to enter into an explosion, or enough to make 20,000 to 60,000 linear feet of mine entry dangerously dusty if the material were distributed at the rate of 1 pound per foot of entry.

Coals with volatile combustible only slightly in excess of 10 percent are likely to be somewhat difficult to ignite even in a finely divided state and in a dust-air cloud; however, coals of this description do ignite under some conditions and may propagate an explosion with extreme violence. Coals with high-volatile combustible, although easily ignited when in a dust cloud, will not necessarily propagate an explosion with greater violence than those in which the volatile combustible is but little more than 10 percent.

As heretofore indicated, coal-dust explosibility is proportionate to volatile combustible, fineness, dryness, and freedom from incombustible. The influence of proportion of volatile combustible present and of fineness have been discussed. It is manifest that very finely divided coal which is thoroughly *wet* can be formed into a dust-air cloud only with great difficulty; hence such material is practically free of the danger of either ignition or propagation in connection with explosions. However, unless the finely divided coal dust is definitely wet, it can under some circumstances be thrown into the air and can then enter into explosion propagation in some cases even when about 10 percent of external water is present in the coal dust. Hence when the wetness of coal dust is well defined or fairly close to the saturation point, there is comparative immunity from explosive ignition; on the other hand, immunity from propagation of a well-started explosion can be definitely secured by moistening only when the "dust" is essentially in the form of mud or at or beyond saturation. Saturation of coal dust with external moisture is obtained when about 20 percent of external moisture is present. Fine coal in this condition is essentially mud and is essentially free from the danger of either initiation or propagation of an explosion; however, some sub-bituminous or lignitic coals contain 20 percent or more of water of composition, or inherent moisture, but that does not prevent them from initiating or propagating an explosion. It can readily be seen that watering methods as the sole means of explosion prevention in coal mines are likely to be ineffective unless the work is done with extreme thoroughness and with a degree of constancy of application almost impossible of attainment under present-day mining conditions. Watering methods, however, have a well-defined place in the health and safety of coal-mining operations in that the free use of water at and around the face

Showing the dustiness brought about by dry cutting of coal. The air is filled with very fine dust and this definitely dangerous material settles on immediate and adjacent mine surfaces to be available to aid in extending any ignition which may occur.



Using water on the machine cutter bar while cutting prevents dust from getting into the air, and even more important, prevents the cuttings from distributing dust more or less throughout the mine, where they are later on loaded into cars and hauled to the surface.

region, especially on the cutting chain of mining machines, on loading, conveying, and similar face machinery as well as on the coal piles being loaded, and on the face surfaces, tends definitely to prevent the scattering of fine dust through the air and through the mine; possibly it is of even more importance that the wetness of the face region may prevent coal dust from augmenting incipient gas ignitions which are so prone to occur at or near faces, especially those at which open lights, black blasting powder, or electrical equipment are being used.

The statement has been made that one of the features affecting the explosibility of coal dust is its freedom from incombustible matter—ash, external moisture, etc. However, there are practically no bituminous or lignitic coals which are used commercially that have in themselves enough incombustible to prevent their dust from being subject to explosion ignition or propagation. The lower the proportion of volatile combustible matter is in coal, the less incombustible is necessary to prevent initiation or propagation of an explosion of that coal; however, no commercially used low-volatile coals of which the volatile combustible is 10 percent or over have been found with sufficient incombustible in themselves to prevent initiation or propagation of an explosion. In the dust sampling of various kinds of places in mines, the dusts at or near the face region usually have less than 10 percent incombustible except in coals where the inherent or combined moisture is high. Samples taken from haulage roads and similar places in mines which have not been rock-dusted in some cases have an incombustible content of over 30 percent, and occasionally higher, due to the mixing of the roof or floor material or the sand used by locomotives with the coal dust. Rarely, however, does a sample from mine surfaces which have not been rock-dusted show an amount of incombustible, whether of moisture or ash or both, sufficient to prevent either the initiation or the propagation of an explosion. Although for the low-volatile coals a smaller percentage of incombustible is required to be present to prevent initiation or propagation of an explosion, in general at least 55 percent, and preferably 65 percent, of incombustible should be present to prevent extensive explosions in our coal mines.

In the foregoing paragraphs it has been shown that in practically all of our bituminous and lignitic mines the finely divided dust is explosive. There is much more than enough dust present, in combustible state, sufficiently finely divided and sufficiently dry, either to ignite or to propagate an explosion if thrown into a dust-air cloud; and the entire preceding discussion has been in connection with air conditions in which explosive gas is wholly absent. If explosive gas is present, the dangers are very greatly augmented: for instance, if 65 percent of incombustible matter is required in the dust to prevent explosion propagation in air free of methane, about 72 percent incombustible would be required if the surrounding air contained 1 percent methane, 79 percent incombustible with 2 percent methane, 86 percent incombustible with 3 percent methane, etc. Moreover, under some conditions as little as 100 cubic feet of an explosive mixture of methane and air may initiate a widespread explosion if fed a sufficient amount of fine pure dry dust immediately, a condition only too likely to occur at or near dusty working faces. An explosion initiated by methane generally has a much more violent start or "kick" than one originating from dust alone, and this violence tends to the formation of the dust-air clouds whose ignition quick and violent forwards explosions.

In conclusion, there is no question that the correct answer to the title of the paper, *When Coal Mines Are Dusty*, is "always." There are very few bituminous, semibituminous, subbituminous, or lignitic mines which have not places (generally every place, unless the mine has been rock-dusted or there is present much disintegrated incombustible roof or floor material) with dust conditions such that a coal-dust explosion may be initiated and propagated; and in general there are very few which have not readily available the means of ignition in the form of open lights, electric arcs, use of black blasting powder or dynamite, or misuse of permissible or other explosives, in firing with fuse, or in the employment of so-called bull-dozing, adobe or sand blasting shots, etc. Accordingly, every coal mine, except possibly those mining high-grade anthracite, should be kept rock-dusted over all accessible surfaces which are not definitely wet; all coal mines should use only permissible closed lights, permissible electrical equipment, and permissible explosives; and all mines should be kept so thoroughly ventilated that in no unsealed place in any mine should there be present more than 1 percent of explosive gas. Not until these requirements, as a minimum, are in effect and maintained in an effective manner will the coal mines of the United States avoid the present unsavory record of killing 300 or more mine employes annually by explosions.

ANTI-FRICTION BEARINGS *In* MINE LOCOMOTIVES

By A. R. ANDERSON *

Anti-friction bearings cannot increase power or speed of locomotive appreciably—Reduced maintenance is the real item of value—Armature shaft first consideration—Motor axle bearings less important—Not evident that advantages outweigh disadvantages of anti-friction bearings for locomotive journals

ALL machinery bearings require lubrication and all, with the possible exception of some bearings in large stationary units, where elaborate provision is made for keeping the bearings floating on a film of oil, actually wear.

The problem of lubricating a bearing is influenced by speed, bearing pressure, its accessibility in the machine, and often whether or not the operating schedule of the machine or equipment permits of effective and systematic lubrication. The wear on a bearing depends in the main on how well effective lubricant is applied and how well it is protected from abrasive dust.

The foregoing considerations influence the selection of bearings in a mine locomotive, as in most other machinery. Assuming for any type of bearing that it will be provided with proper lubrication, it is only in exceptional cases, or chiefly in the types of machines that come under the classification of instruments, that the actual power required to overcome friction in the bearing is a factor in determining the type of bearing. It certainly is not a factor determining the type of bearings in a mine locomotive. Anti-friction bearings, for example, in a mine locomotive neither change the electrical characteristics of the motor, nor do they increase the weight of the locomotive. Therefore, they have no influence on either the speed of the locomotive nor the number of cars the locomotive can haul. The amount of power that is lost in properly designed and properly lubricated bearings of any type in a mine locomotive is so small that it would be exceedingly difficult to measure it under service conditions. Where anti-friction bearings are applied to mine locomotives, they are not applied either to increase the speed of the locomotive, increase the number of cars that the locomotive will haul, nor to effect a saving in the power consumed by the locomotive. All this may seem rather elementary, but that it is not clearly understood by even manufacturers who make a specialty of bearings is evidenced by recently published statements regarding increased locomotive speed and increased load a locomotive would haul, by reason of applying anti-friction bearings to the armatures of the locomotive motors.

Reduced maintenance and freedom from service interruptions are the results sought in the selection of bearings for mine locomotives. The most suitable bearing is the one that gives these results, and the points in connection with lubrication and wear, mentioned at the outset, have to be considered in determining the most suitable bearing.

In a mine locomotive of standard construction—that is, one in which the motor is supported on the axle and drives the axle through single reduction spur gearing—there are three bearing points each one of which has essential requirements that are distinct from the others. Because some porticular type of bearing has been found most suitable for the armature shaft, for example, it does not necessarily follow that this same type of bearing is the most suitable for the axle journals. In view of the efforts that are being made to make more general application of anti-friction bearings to mine locomotives, it may be of interest at this time to analyze briefly the bearing requirements at these three points.

On the armatures of mine locomotive motors, the application of anti-friction bearings has now been standard practice with some manufacturers for about twenty years. The speed of an armature on a standard mine locomotive is from 400 to 500 r. p. m., and, while this is by no means a high speed, it is the highest speed shaft on the locomotive, and the one which would logically come in for first consideration so far as lubrication is concerned, both from the standpoint of maintaining proper lubrication and also avoiding an excess of lubricant which it would be difficult to keep from working its way into the motors, where it would have a deleterious effect on windings, commutator, etc. The difficulty of keeping the bearing sealed to prevent excess oil from entering the motor would increase as the bearing wears.

Because of the restricted width of the motor, which with its gearing has to fit between the locomotive wheels, especially where large capacities are required on narrow gauges, it was not always possible to get as long a bearing as might be desired to keep bearing pressure, wear, and oil seepage to a minimum, nor was it possible to very effectively seal the bearings against oil seepage to the inside of the motor and against abrasive dirt working its way into the bearings. In an electric motor, the clearance between the armature and the pole pieces is an important detail of the electrical design of the motor and can not be made too great. Wear in the armature bearings would throw the armature out of its normal electrical center, put unbalanced strains on it, and if the bearings were not rebushed before the wear had gone too far, the armature would finally rub on the pole pieces, damaging the motor so that it would require a major repair. Worn armature bearings also interfere with proper commutation.

With the use of anti-friction bearings on the armature shaft, all these details are more easily and more effectively taken care of. There is ample room within the overall dimensions of the motor as determined by the electrical design to provide anti-friction bearings of ample capacity of either the ball bearing or roller bearing type, and further room to so house them that they are adequately protected against abrasive dirt getting into them and properly sealed against any excess lubricant getting into the motor. The more viscous form of lubricant that may be used with anti-

* Engineer, The Jeffrey Manufacturing Co.

friction bearings does not have the same tendency to seep out as do lighter oils and is better retained in the bearings so that it is possible to make better provisions to drain off any excess lubricant. Because it is possible with anti-friction bearings to provide bearings of ample capacity and still have room to properly house them, anti-friction bearings will operate for relatively long periods of time without appreciable wear and this, in turn, maintains effective such seals as are provided against oil getting into the motor and abrasive dirt getting into the bearings. Long before the bearing wears to a point which would let the armature down on the pole pieces and cause major damage to the motor, the wear of the bearing will become evident and the bearing can be replaced. With anti-friction bearings on the locomotive motor armatures, maintenance is so much less and freedom from service interruptions so much greater that this application of anti-friction bearings has become the accepted standard.

The next bearing to be considered in a mine locomotive is where the motor is supported on the axle. The standard practice here is to use large bronze bushed bearings. The speed of the axle is slow, less than 100 r. p. m., and these bearings can be and are made with very large bearing surface for the relatively small load on them. The load on these bearings is only the resultant of the weight of the motor and the pressure on the gear teeth, which load is equally shared with the suspension lug on the motor suspension bar. With low speed, light bearing pressure, accessibility for lubrication, and no need to be concerned with what becomes of excess lubricant, these bearings have taken care of themselves very well and have not invited very close scrutiny. In many locomotives, not even ordinary precautions have been taken to keep abrasive dirt out of these bearings. Even under these conditions, the life obtained from these bearings has been so satisfactory and the cost of replacement has been so insignificant that no particular complaints have been lodged against them.

It is, however, important that wear on the motor axle bearings be kept to a minimum in order to maintain correct gear centers. Many damaged armature pinions and broken armature shafts can be traced to axle bearings that have been allowed to wear, permitting gear centers to shift and spread, and putting strains on the armature pinions and shafts that will eventually break them. As a rule, the axle bearings do not wear equally and, in addition to gear centers spreading, the parallel relation to the armature shaft and the axle is destroyed when one axle bearing wears more than the other. This is evident by the way in which armature pinion teeth usually wear tapered toward one end.

If ordinary precautions were taken to keep abrasive dirt out of the axle bearings, if systematic lubrication of them were provided for, and if systematic inspection and replacement of bearing bronzes, which is not costly in either time or money, were made before these bearings become too badly worn, there would be little reason to consider any other type of bearing for this use. The plain bronze bearing has the distinct advantage of being simple, inexpensive, and permitting of the utmost accessibility and ease in removing motors or wheels and axles from the locomotive. The care and attention they require, as indicated above, should not be unreasonable to expect, but in the average mine they are neglected and are not taken care of until a broken armature pinion or armature shaft results.

For this reason, some consideration has been given to the use of anti-friction bearings for supporting the motor on the axle. Such bearings properly housed to retain lubrication and exclude abrasive dirt, would have relatively little wear and would maintain proper gear centers, and probably avoid many broken armature pinions and armature shafts.

The designer, however, is beset with many difficulties in applying anti-friction bearings to the motor axle bearings. Space must be found for mounting bearings that are large enough to go over the axles, and yet they can not be permitted to cut into the motor frame to interfere with field coils, nor can they be mounted at the ends of the motor frame where they would increase the width of the motor and interfere with placing it between the wheels. Some promising work, however, has been done in applying anti-friction bearings to axle bearings on the mine locomotive motor, and it remains to be seen if the increased complication in construction, increased cost, and the added work involved in mounting these bearings on the axle before the wheels are pressed on, will fully justify the advantage derived from longer life and better maintained gear centers.

When the ordinary bronze bushing in the axle bearings wear there is, of course, some corresponding wear of the axle, and axle replacements in time become necessary on this account. With anti-friction bearings to support the motor on the axle, it is thought possible that the axle will last indefinitely and cease to be considered a replaceable part.

Although the use of anti-friction bearings to support the motor on the axle is still in its initial stages, and several years will probably be required to get a true measure of its value, it may be said at this time that the use of anti-friction bearings at this point should logically result in reduced breakage of armature shafts and pinions, reduced wear on gearing, and eliminate the necessity for replacing axles, due to wear at the axle bearings.

The third bearing on mine locomotives, regarding which there has been considerable discussion recently, is the journal for the axle. The simple, inexpensive, and easily replaceable bronze linings that have been used in journal boxes for years, and which are still standard, serve the purpose so well that it is only seldom that any other type of bearing is seriously considered for this purpose. It is true that in the last year or two there has been considerable agitation for the use of anti-friction bearings in locomotive journals, but the advantages of anti-friction bearings at this point are not so numerous, nor is it evident that they so outweigh attendant disadvantages as to warrant a speedy departure from the standard bronze bearing. The fact that the advantages of roller bearings in mine car journals, for example, have been widely accepted does not, by any means, indicate that they are the most desirable for locomotive journals.

While roller bearings in mine car journals greatly reduce the friction of the load, and on level track enable locomotive to pull more roller bearing cars than plain bearing cars, and do, in a very apparent way, correspondingly reduce the power taken, the saving in power that could be effected by applying roller bearings to the journals of a mine locomotive would be exceedingly difficult to find.

Even in mine cars, saving in power is not the most pertinent reason for the use of roller bearing journals. The indifferent way in which plain mine car journals are lubricated is a familiar story. It usually portrays a boy standing off at a distance and squirting oil at the car wheel as it passes. Without proper lubrication, bearings do not last long, and the cost of replacing bearings, buying oil that is not properly applied, and the labor of spraying this oil on the car wheels, are items of continuous maintenance expense which the roller bearing in the mine car journal is calculated to offset.

In a mine locomotive, however, the situation in regard to journal bearing maintenance is somewhat different. Journal boxes on a mine locomotive are carefully designed to make adequate provision for lubrication of the bearings, and inasmuch as mine locomotives are much fewer in number than mine cars, and are usually brought to a central point at the end of each shift where systematic inspection and maintenance can be provided for, it is a relatively simple matter to provide for systematic lubrication of the journals. Normal

wear on a journal box lining does not in any way interfere with the operation of the locomotive, and when it does become necessary to replace the worn journal box linings, this is very easily and quickly done at but little expense.

It is true that where the journal box is inside the wheels, as in the case of an outside wheel locomotive, the journal box is not always so easily accessible for lubrication, but this can be provided for by a duct extending to the top of the locomotive frame. Also it is true that journal box linings on outside wheel locomotives are not as easily replaced as journal box linings on inside wheel locomotives, and also that end thrust is not as well taken care of on brass collars as it might be with roller bearings in the journal box. It so happens, however, that the journal box inside the wheel also presents the biggest problem in the application of roller bearings. The roller bearings can not be put on or taken off the axle without removing the wheels from the axle. This makes replacement of the bearing quite a task should replacement of the bearing for any reason become necessary. The bearing inside the wheel is also inaccessible for adjustment, and proper adjustment of roller bearings is important. For every set of spare wheels and axles, it is necessary to provide roller bearings and journal boxes in order to avoid the delay and expense of pressing wheels on and off in order to interchange roller bearings and journal boxes when wheels and axles are changed.

On inside wheel locomotives, on the other hand, where roller bearings are more easily applied, the advantages of roller bearings are not so evident. With journal boxes outside the wheels they are readily accessible for systematic and proper lubrication, journal box linings are most easily and quickly replaced whenever this becomes necessary, and with a hardened steel thrust pin in the end of the axle, bearing on a hardened steel plate in the journal box cover, end thrust is just as adequately provided for as with roller bearings. As a matter of fact, all roller bearings do not provide for end thrust and where they do not end thrust is taken care of with a thrust pin in the same way.

It is not the intention here to make any prediction in regard to the ultimate adoption or rejection of anti-friction bearings in locomotive axle journals. It is merely intended to set forth some important considerations in connection with roller bearing construction in journal boxes, and to indicate that there is still plenty of room for a difference of opinion in regard to the use of roller bearings. Especially so for inside wheel locomotives, where there is so little evidence of improvement or advantage to be gained in either operation or maintenance over the standard bronze journal box linings. Whatever advantages there may be in roller bearings for outside wheel locomotives, their application has attendant disadvantages. In their application, there is still something to be learned when manufacturers recommend, for example, that the inner race be shrunk on the axle or be a pressed fit, and at the same time suggest that adjustment be made by moving this inner race on the axle with an adjusting nut. Here, again, several years' experience will probably be required to indicate anything definitely regarding the status of roller bearing axle journals on mine locomotives. In the meantime, manufacturers of anti-friction bearings who are urging their use for this purpose should be expected to study very carefully their application and be prepared to make carefully considered and definite recommendations regarding the manner of mounting and housing their particular makes of bearings.

COAL STORAGE
(From page 202)

In every such case, the cured coal serves as the kindling, while the fresh coal furnishes the autogenous heat to ignite this kindling.

Sometimes fires are induced because of the conductance, by metal pipes, rails, or wire fences, of heat from an outside source such as the sun on a summer day.

Air Expulsion

The foregoing discussion places upon ordinary air prime responsibility for the spontaneous heating and firing of stored coal. If coal could be deprived completely of the air that goes ordinarily into a storage pile, it would unquestionably be as safe against fire as though it were under water or were sealed hermetically. An effort at the exclusion of fresh air is made when coal is stored in concrete structures resembling silos, but the average results are no better than for ordinary out-of-door pile storage.

Instead of air exclusion alone, the problem calls for air expulsion and air exclusion. This fact is coming into recognition slowly among storers of soft coal. Complete expulsion of air is not feasible but an efficiency of around two-thirds may be accomplished very simply and at slight expense. Any expense incurred in preventive measures of this sort is well warranted for it is much less than the premium of any other form of insurance.

At the East Chicago plant of the Northern Indiana Public Service Company, Indiana screenings are unloaded from cars by a locomotive crane, the bucketfuls being dropped 4 to 6 ft. in such a manner as to form a checker of small mounds. Succeeding bucketfuls are deposited similarly but in the depressions between the first mounds. When the site has been covered in this manner, the clamshell is detached from the crane and replaced by a home-made tamper or heavy weight, about 4 ft. square and weighing 2½ tons. This is hoisted and dropped about 5 ft. upon the apex of every mound of coal, with a resulting compression that is really interesting. This process is repeated by successive layers until the pile is finished.

At the Lafayette plant of this same company, the Indiana screenings are handled by a stationary crane from the cars to a single large pile whence they are spread by a dragline bucket into a fan-shaped layer about 17 in. thick and 200 ft. long. When a layer is spread in this manner, a home-made, two-ton roller is substituted for the bucket in the dragline and is drawn back and forth several times over every part of the pile until the layer is compressed to an average thickness of about 13 in.

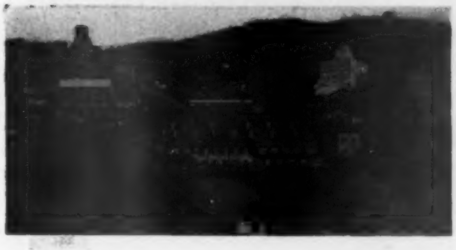
Each of these methods not only expels a major part of the air but it squeezes the finer particles of coal into the voids in the coarse coal and thereby prevents the baneful effects that are assigned ordinarily to so-called segregation during loose piling. Furthermore the surface of each layer and of the finished pile is made almost as dense as a pavement and hence it restricts the filtration or diffusion of air into the pile.

This proposition of placing a physical limitation upon the quantity of air that is left within the voids of the pile during the placement of the coal deserves consideration by every operator who practices out-door storage. He can adopt either of the practices just described or he may devise any other scheme that will best match his present equipment or his scale of operations. In some cases men have tamped the layers of coal manually, with wholly satisfactory results and at low cost.

Ten fellowships in the chemistry of coal and coal products, coal mining and preparation, and ferrous metallurgy are being offered for the next college year at Carnegie Institute of Technology in cooperation with the Pittsburgh Experiment Station of the U. S. Bureau of Mines and Advisory Boards representing mining and metallurgical industries.

Fellowships, it is announced, are open to the graduates of colleges, universities and technical schools who are qualified to undertake research investigations. The period of the studies under each fellowship will be from August 12, 1929, to June 10, 1930. Fellowship holders will register as graduate students and become candidates for the degree of Master of Science.

PRACTICAL OPERATING MEN'S DEPARTMENT



METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry

DRAINAGE *and* PUMPING *at the* CRESSON MINE

By GUY RORABAUGH*

PRIOR to June, 1923, there was no pumping problem at the Cresson mine, as the Roosevelt deep drainage tunnel connected with the 17th level at a depth of 1,930 ft., which was the bottom of the shaft, except for a sump about 15 ft. deep.

As the ore continued below this depth, it was decided to sink below the tunnel level, and from the knowledge gained from the previous history of the Cripple Creek mining district, it was anticipated that it would be necessary to handle considerable water, but not in the quantities which were subsequently encountered.

During the sinking of the shaft to the 18th level the water was easily handled by a 9B Cameron sinking pump, using compressed air as motive power.

At the 18th level, 127 ft. below the tunnel level, a station and pump station were cut and the first installation of electric pumping equipment installed. The original installation on this level consisted of three 400 g. p. m., 4-stage, Manistee centrifugal pumps, direct connected to 35-hp., 30-cycle, 2,200-volt General Electric induction motors. There was later added to this equipment a 700-g. p. m. and a 300-g. p. m. Manistee, making a total pumping capacity on this level of 2,200 gallons per minute. This proved inadequate at times as the headings progressed, as it was occasionally necessary to close the steel pressure doors which had been installed to control the flow of water to the pumps.

Sinking was resumed upon the completion of the pump station at the 18th level and the shaft extended to a depth of 340 ft. below this point, where it was necessary to plug the last round of holes drilled in the shaft because more water came in than could be handled by the 9B and a 14 x 8 x 12 inch Prescott duplex sinking pump.

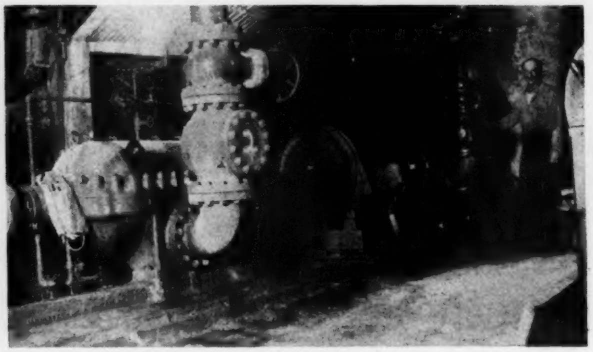
Provision had been made at a point 254 ft. below the 18th level for a station. This was immediately started and preparations made to handle more water than was encountered on the 18th level.

A main station 28 x 80 ft. and a pump station 20 x 80 ft. were cut and a rather elaborate sump system devised, consisting of a settling sump 5 ft. wide by 10 ft. deep by 50 ft. long, with the main

The Cresson Mine

Increasingly difficult water conditions met below Roosevelt drainage tunnel—18th level required equipment for 2,200 gallons per minute; 19th level, 5,200 gallons per minute—Steel pressure doors in drift to control flow of water to pumps—2,200 volts taken underground—Costs given

* Master Mechanic, Cresson Cons. Gold Mng. Co., Cripple Creek, Colo.

Two views of the pump station on the 2,000 level of the Cresson Mine

sump the entire length of the station, 6 ft. wide and 15 ft. deep.

The main sump was divided by a cement wall between the No. 2 and No. 3 pumps and provision made to divert the water to either compartment. By this arrangement the sump could be cleaned out, one-half at a time, without shutting down all of the pumps.

The pumping equipment in this station consists of four 700-g. p. m., Type H, horizontally split, four-stage centrifugal pumps, each direct connected to 125-hp., 2,200-volt, 1,800-r. p. m. G. E. motors, and one Worthington 1,200-g. p. m. direct connected to a 200-hp. G. E. 1,800-r. p. m. motor.

As the headings on this level were advanced the water on the 18th level receded and two of the 400-g. p. m. pumps were moved to the 20th level and connected in series, which gave a total pumping capacity of 4,400 g. p. m. on this level.

Work was also started on the 19th level, where a flow of about 1,200 g. p. m. was encountered, and by this time the 18th level was drained. A small pump station was cut on the 19th level and the last two Manistees moved there to take care of part of this water, the balance being allowed to go down a raise to the 2,000 level to be taken care of there.

This gave a total pumping capacity of 5,200 g. p. m., which has been used up to full capacity until the last few months.

The 700 and 1,200 gallon pumps on the 20th level are set end to end the entire length of the station and the two 400-gallon pumps across one end. A 14-inch header runs the entire length of the station above the discharge openings of the pumps. Between each pump and the header is an 8-inch gate valve and swing check valve. Paralleling the header is a 1-inch priming line which is connected to the priming valves of each pump.

Each pump has an individual suction pipe with foot valves and strainers. The strainers were made of bronze screen wire 5/32 inch in diameter by ⅜ inch mesh. The screens were fabricated in our own shop. Each screen is in the form of a cylinder split longitudinally and composed entirely of the screen except for a 1½ x 1½ x ¼ inch angle iron which forms the edges and clamp for the pipe. The screen wire was bronze welded to the angle iron with the acetylene torch. By this method of construction it is a very simple matter to remove a screen from the foot valve in case it should need repairs.

The water is carried through a 14-inch line to the shaft, where it divides through a 14 x 10 x 10 inch back outlet return bend connected to two 10-inch columns. At the 17th or tunnel level the water passes through two 12-inch No. 16 gauge lines carried overhead a distance of 800 ft. from the shaft, at which point the grade is downward to the main drainage tunnel. From the Cresson shaft to the portal of the drainage tunnel is a distance of 6 miles.

Power is purchased from the Southern Colorado Power Company and is supplied to the mine substation three-phase, 22,000 volts, 30-cycle. In the substation the current is stepped down to 2,200 volts and carried through two separate cables buried underground to a junction box near the shaft. One cable is installed in the manway while the other cable is carried through a 3-inch bore hole to the 17th level, and from this point down the third compartment to the 20th level.

The shaft is only two compartment to the 17th level, one compartment being used as the skip compartment and the other as a counterbalance and pipe compartment. It was feared that in case of a wreck in the counterbalance compartment it might put the power cable out of commission for a long enough time to flood the pumps before the cable could be repaired; hence, the necessity of the borehole.

Each power cable is a stranded, three conductor, varnished cambric insulation, lead covered over all. The bore hole cable is finished with an outside wire winding having a long pitch which makes it self-sustaining up to a length of 1,000 ft.

In the substation the cover is carried from the secondary side of the transformers to the main switchboard. Each cable has an individual meter, each controlled by an oil switch with overload relays.

In the pump station each cable comes in to a switch. A section of cable was used for the buss along one side of the pump station, taps being taken off for each compensator and a switch placed between the cable and compensator. By this arrangement any compensator could be cut out for inspection and repairs without stopping any of the other pumps. The only exposed wirings are the blades of the switches which have guards placed around them.

After five and one-half years of continuous operation the installation has proved a complete success. We have never had to rewind any of the larger motors and only two of (*Continued on page* 246)

Two 400-g. p. m. pumps on the 2,000 level, connected in series. Normal lift is 250 ft.; as used—381 ft. Metered capacity, 400 g. p. m.

Moving mining machinery and supplies with tractors over snow roads in Manitoba

The ease of moving this portable compressor as compared with a steam outfit is readily apparent

COMPRESSED AIR *for the* SMALL MINE *and* PROSPECT

By E. H. PAULL *

Scientific prospecting of today contrasted with the days of the "Forty-Niner"—Prospector of today may be big producer of tomorrow—Description of equipment suited to prospecting and small mine operation

THE age of miracles has not entirely passed for the men of the mining profession. New machines are continually being perfected, and the wide range of equipment and facilities now available has completely changed miners' methods and their living conditions.

The short span of 80 years since the days of the "forty-niner" has brought forth many changes that are little short of marvelous. Needless to say, compressed air and air-operated machines have done much in that interval to revolutionize mining methods.

In place of the burro loaded down with picks, shovels, washing pans, and the like, the prospector of today starts on his well-planned trip with a small air compressor, air-operated drills, made-up drill steels, maps of the country, etc., all neatly packed in an automobile, truck, or even in an airplane. Instead of guessing as to what is and what is not pay rock, and laboriously picking, breaking, screening and washing, the modern prospector can determine the location of ore bodies by the use of sensitive instruments or by geophysical exploration even though the deposits may lie many feet below the earth's surface. Thus much of the guesswork is eliminated and unseen ore bodies are revealed.

It is only too true that most of us give little or no thought to the work of the prospector. In this age of hustle and bustle and of mass production all interest is centered on speed and increased output of established mines. This fact is forcibly brought to our attention by the glaring headlines and advertisements in our daily papers and trade publications, all of which emphasize enormous output and new production records.

The mass production of our large properties is a wonderful thing, but let us not forget that the bigger the production the quicker the ore reserve will be worked out. Let us remember also that most great mines had modest beginnings and that the prospects of today may be the record breakers of tomorrow. With this in mind we, both as individuals and corporations, should more carefully consider the needs and the demands of prospectors and small producers—mines with outputs of 50, 100, or 200 tons a day.

The lack of attention on the part of machinery manufacturers to the small producer was forcibly brought to a focus at the last meeting of the Western Division of the American Mining Congress at Los Angeles in September. It was emphasized at that time that all manufacturers stressed bigger production and principally advertised equipment for the larger mines. The point was well taken by the editors of THE MINING CONGRESS JOURNAL, and they determined to help the smaller properties by placing before them the equipment best suited for their needs. It is with this thought uppermost that the writer will tell something about the modern machines that supply compressed air and endeavor to make plain to what extent compressed air can serve the small operator.

Probably one of the reasons for this seeming disinterestedness on the part of manufacturers is the lack of prospecting in the United States. With the exception of the Southwest, little is being done in other sections. Canada, however, still has much undeveloped country, and pros-

* Mining Engineer, Ingersoll-Rand Company.

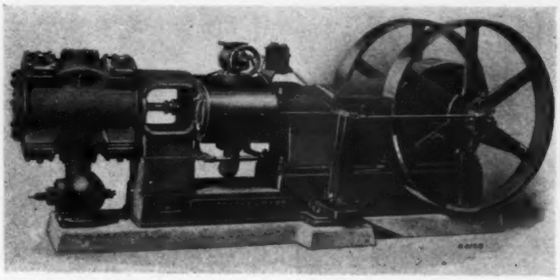


Figure 1. Portable steam-driven compressor

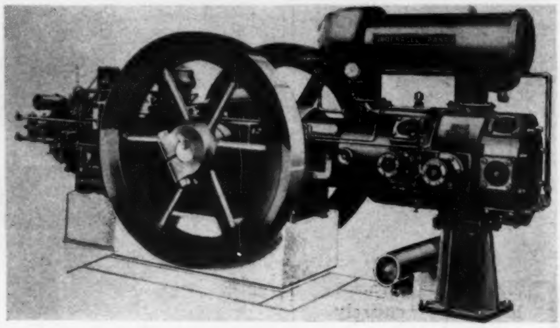


Figure 3. Direct-connected oil-engine compressor

Figure 2. Portable gasoline-driven compressor

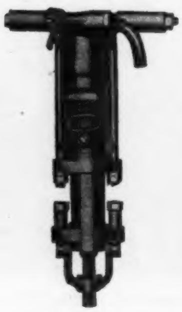


Figure 4. Jack-hammer drill

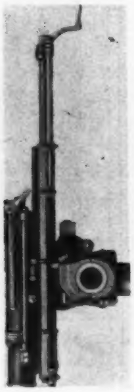


Figure 5 Drifter drill

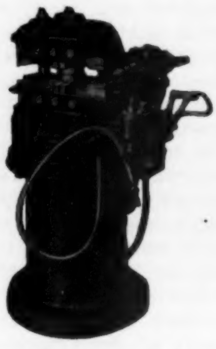


Figure 6. Drill sharpener

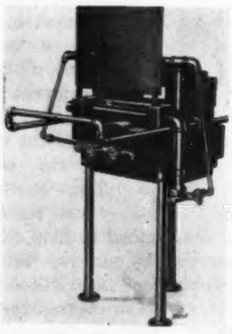


Figure 7. Oil furnace for heating drill steel

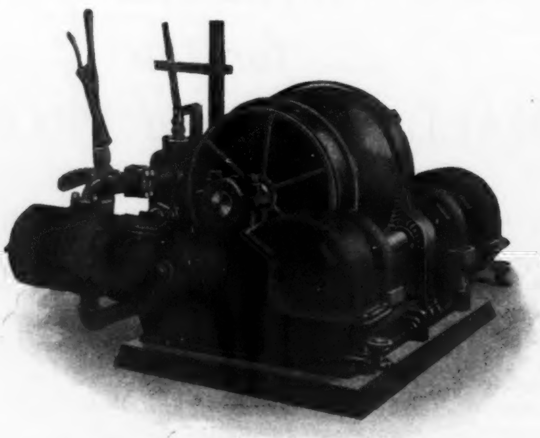


Figure 8. Small compressed-air hoist

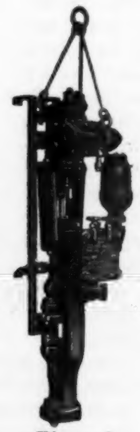


Figure 9. Sinking pump, steam or air-driven

pecting there is being carried out on a large scale.

The Ingersoll-Rand Company has always maintained a keen interest in the doings of the prospector and has developed many new machines that have revolutionized his work. From the experience gained in working with prospectors and in small mines, the company has prepared lists of equipment best suited for any size of plant ranging from the small prospecting plant to the medium-sized mining plant with hydro-electric power.

THE COMPRESSED AIR PLANT

Because drilling operations play such an important part in mining, one of the first problems that confronts the prospective mine owner is the selection of the proper compressed-air plant. The size and type of equipment and the

method of driving it require careful consideration. The size and type of equipment is determined largely by the funds available, transportation facilities, and the speed with which the program of development is to be carried out. The selection of the proper method of drive usually depends on local conditions—such as the relative cost of various fuels—and it has an important bearing on operating costs.

Occasionally a mining claim is developed close to a hydroelectric power line, but in the majority of cases some form of prime mover is necessary. When wood or coal is obtainable at moderate cost, a steam-driven plant is usually chosen. This may be converted to motor drive later on should progress in the district render that permissible.

Lighter and more efficient types of steam plants have made it possible to explore properties that were once considered too inaccessible to warrant serious attention. Very often, however, the cost of coal or of good wood fuel, and the difficulty of transportation, make the operation of steam plants prohibitive. Under such conditions, gasoline or oil-driven plants are more suitable and are now being used extensively.

When there is any doubt as to the ultimate value of a prospect, or where it may be desirable to move the plant about the property, a portable unit, moderate in first cost and easy to transport, is the logical type of equipment to select. The earlier forms of portable compressors did not possess the necessary strength nor were they sufficiently reliable for this class of service. Within the past few years, however, the portable gasoline-driven compressor has been greatly improved, and its record of achievement in the field of construction has led to its adoption for trenching, shaft sinking, tunneling, and other operations essential to the development of mining prospects.

It has been proved that the portable gasoline-driven compressor plant not only is easier to transport over bad roads, rough country and lakes and streams, but can be put to service more quickly than other types of equipment. The fuel used compares favorably in cost with coal or wood, is readily obtainable as a rule, and offers no transportation difficulties. Its initial cost is generally lower than that of a permanent oil or steam-driven plant, and the necessary foundations and buildings call for only a moderate expenditure.

Oil-engine drive usually is marked with high operating economy, and where conditions will permit the use of such plants they are to be preferred. They require, however, a fairly heavy initial investment, and the foundations must be of a substantial character. Should the prospect turn out to be valueless, then the plant will have to be torn down before it can be placed on another property, thus incurring additional expense in moving and setting it up again.

In a paper entitled "Internal Combustion Engines for Mining Purposes," which was presented at the March, 1928, meeting of the Canadian Institute of Mining and Metallurgy, Mr. F. A. McLean, of Sherbrooke, Quebec, states: "The steam plant has been so extensively used in the past, and the portable gasoline-driven compressor has become so popular for prospecting during the past three or four years, that there may be a tendency to install either of those types in some cases where the improved form of oil-engine plant, as now available, would prove to be a far better investment. Actually, for each type there appears to be a certain field of employment governed by local conditions. With these things in mind, let us compare some of the characteristics of the three types."

Mr. McLean outlines the field of application of each of the power-supply plants as follows:

Field of Steam-Driven Mining Plants

While the high cost of wood and coal, poor transportation facilities, and similar difficulties have led to the use of gasoline and oil in preference to steam, there are localities where steam-driven compressors can be used to advantage. Steam-compressor design has kept well abreast of the developments in other types, and the operator of today has a far better and a more efficient range of machines to draw upon than in the past.

For developing prospects the straight-line, single-stage type (*figure* 1) has been very popular. Many of the now famous Canadian producers were opened up with this class of machine or earlier models of it. The units are simple and very rugged, and they are easily dismantled for convenient transportation. The original plants on the Moranda and Abana properties, and the Jackson-Manion and Malartic plants, are of this kind. When larger capacity is required, the two-stage duplex unit is usually installed.

Comparatively speaking, labor costs are higher with the steam plant, but under favorable conditions some very good records can be made with such plants. An example of this kind is the Howey property at Red Lake. This plant consists of two 60-horsepower boilers, a steam-driven, cross-compound compressor and an 8¼ by 10 hoist. The boilers and all pipes are carefully insulated, and everything is laid out with the idea of obtaining maximum efficiency. As a result of this policy, and the use of a good grade of wood, the fuel consumption has been remarkably low, and the cost of sinking the three-compartment shaft so far has not exceeded $85 per foot.

Field of the Portable Gasoline-Driven Plant for Prospecting

Portable compressors are especially valuable for opening up remote properties where heavy machinery can not be taken in or where it is desirable to get operations well started pending the shipment of heavier equipment. The one and two drill sizes are lighter than any other type of plant of the kind available today, and will permit work to be carried on at a favorable rate that would otherwise have to be done laboriously by hand steels. On a small northern Ontario operation a 5½ by 5-in. unit, weighing about 2,800 pounds complete, is used to operate a "Jackhamer" on shaft sinking. With this equipment a round of seventeen 5-ft. holes is drilled in an eight-hour shift—the gasoline consumption averaging 10 gallons, or 90 pounds per shift. At 40 cents per gallon, this comes to $4 per shift. As the compressor needs little attention, the total cost of power is low indeed. During the past year there has been an increasing tendency to use the smaller portable for surface trenching and for sinking small exploration shafts and test pits because they permit such work to be carried on at higher speeds and greater economy than do hand methods. A number of Quebec properties have adopted this procedure.

Portable gasoline-driven compressors are also well suited for the opening up of properties on which the work done is not sufficient to warrant the expenditure for a permanent plant. Under such conditions, or where it may be necessary to move the plant from claim to claim or from one part of a property to another, the mobility of self-contained plants of this type is a valuable consideration. Readiness for service is another important feature where speedy work is required in order to prove up a property before additional payments under an option become due. In the event the option is dropped, the plant can be moved easily and sold readily if desired. (See figure 2.)

On small, high-grade operations the speed with which the plant can be taken in and started up may enable an operator to finance himself through the sale of the ore produced. In one case, which recently came to the writer's notice, the operator of a medium-sized portable plant is said to have obtained $100,000 for ore taken out of a cutting 25 ft. long, 10 ft. wide, and 4 ft. deep. The ore had to be shipped over 40 miles to the railway. This operator stated that the mechanical performance and the fuel and labor costs of the plant were very satisfactory, even though the property was so far from railhead.

In the Small-Operation Field

Another branch of mining for which the small gasoline portable has proved itself better fitted than any of the larger or more expensive types is that in connection with small and intermittent quarrying operations often encountered in the production of feldspar, gypsum and brick shale. A few hours of drilling with jackhamers will not infrequently provide sufficient raw material in workings at this description to keep the rest of the force busy for several days. Under such conditions the cost of fuel is negligible, and the ease with which the portable can be started and stopped, its power to run without attention, and the absence of stand-by charges when idle are important considerations.

Where the Portable Leaves Off the Field of the Oil Engine Begins

From the foregoing it is clear that the portable compressor has made a very definite place for itself and is now looked upon as a valuable piece of equipment for prospecting and for small operations in regions where wood or coal is costly and transportation facilities are poor. The investment compares favorably with that for other kindred plants. When actual capacity is taken into consideration, the differences in weight and first cost between the large sized portable and the oil-engine plant are not so evident, and are offset to a very large extent by the facts that the oil-engine compressor will effect greater economies and operate for a longer period on a ton of fuel. When these facts are given due consideration, the direct-connected, oil-engine plant would seen to be the best all-round investment in many cases where conditions will permit it to be taken in.

Figure 3 shows a type of direct-connected, oil-engine compressor. The same engine without the air compressor may be belted to a generator. Another alternative is to connect the oil engine to both the air compressor and the generator. This arrangement makes it practicable to use an electric hoist as well as to supply compressed air for drilling purposes.

For a prospecting plant which is within reach of hydroelectric power, a belt-driven compressor is the type often first selected. If circumstances make a steam plant the choice, the compressor may be of the same size but with a steam cylinder added. (See figure 1.)

Rock Drills

The character of the rock and the extent and the class of work vary so greatly at different prospects and mines that it is possible to make only general suggestions as to the selection of drilling equipment. Most drill manufacturers keep demonstrators in the field who will gladly investigate conditions and make recommendations.

Jackhamer Drills—This hand-held type of drill is the accepted machine for all prospecting and for most shaft-sinking and other down-hole work even in large mines. They range in sizes from about 20 to 75 pounds. (Figure 4.)

Where the rock is exceptionally hard, some mines prefer the light-weight drifter type of drill fitted with a special handle for shaft-sinking work.

Drifter Drills—For large prospects and mines, where drifting and crosscutting is done, the drifter type of drill mounted on a column or shaft-bar is the ideal machine. (Figure 5.)

Drill-Steel Sharpeners and Oil Furnaces

Modern, high-speed, hammer drills require a large supply of sharpened steels. In return, the drills do so much more work that it generally pays to install a sharpening machine even when as few as two drills are in use.

Sharpeners are built in various sizes: For prospecting, development plants, and for permanent plants using a large number of drills. (Figure 6.)

Oil furnaces also are great time and labor savers. They are ready at a minute's notice, and they are clean, safe and easy to operate and to control. One of these is illustrated in Figure 7.

Hoists

For the prospecting plant equipped with a portable gasoline compressor the compressed-air hoist is the most suitable unit. Figure 8 shows a small hoist of this kind. The valves are of the piston type, the working parts are entirely inclosed and run in oil, the gearing is cut, and there is a powerful hand brake.

As the hoist consumes comparatively large amounts of air during the short hoisting periods, it is desirable to provide an air receiver of good size.

The next step probably will include electric power for hoisting, using either purchased hydroelectric power or power from an oil-engine-driven generator. The drive is through single-reduction, cut-steel herringbone bearing, running in an oil-tight case. The motor is direct connected to the hoist by a flexible coupling. The single-drum hoist is built so that it may be converted later into one with double drums should results justify doing so. This makes a desirable arrangement, as the single-drum hoist may be used in sinking the development shaft and the second drum may be added as soon as production begins, thus furnishing equipment suitable for handling ore by balanced hoisting.

The small electric hoists have the usual safety devices, consisting of a trip brake on the motor pinion shaft that is operated by track-limit switches in the headframe.

For a larger plant the hoist would be provided with compressed-air-operated clutches and brakes and other safety devices.

An economical plan, when developing a property, is to purchase in the first place a hoist large enough for handling ore and, in the meantime, to equip it with a small, slow-speed motor having hand-operated brakes and clutches and a simple pinion-shaft brake. This will save on first cost and keep down the power bills. Later the hoist may be equipped with a larger and a faster motor, air-operated brakes and clutches, and safety devices.

Pumps

For shaft sinking, where there is too much water to be bailed out conveniently, a sinking pump of the type shown in Figure 9 is used. It may be driven by steam or air.

For a permanent plant a centrifugal pump, direct coupled to an electric motor, is usually satisfactory.

ROCK BURSTS IN LAKE SUPERIOR COPPER MINES

Several fatal accidents have been caused in the Lake Superior copper mining region by the occurrence of "rock bursts," the Bureau of Mines points out. The term "rock bursts," is applied to the sudden giving away of rock pillars and walls left in support of underground workings in deep mines. When rock support gives away over extended areas "air blasts" accompanied by local earthquakes occur and in a number of instances these have caused loss of life.

A study of rock bursts in the Lake Superior copper mining district has recently been conducted by the Bureau of Mines. The results of this investigation are summarized in a bulletin by Dr. W. R. Crane, of the Mining Division of the bureau, which will be published within the next few months.

In this forthcoming bulletin, Dr. Crane describes the occurrence of rock bursts and the means of detecting their approach, also, the measures necessary to prevent damage to mine operations. He analyses the cause of rock bursts and the effect of the pressure of superincumbent rock masses on mine support according to the depth of the mine workings and to the dip of the lode or bed.

The action and effect of rock bursts, the failure of pillars or other support and of the hanging wall or roof rock are described and the effect of faults, slips and joint planes on the underground mine support is discussed.

Calumet & Arizona and New Cornelia Will Consolidate

At their meetings on February 19, the boards of directors of Calumet & Arizona Mining Company and New Cornelia Copper Company approved an agreement to consolidate the two corporations, ordered it executed as required by the Delaware statutes and submitted to the stockholders of each company at the annual meeting of each corporation with the unanimous recommendation of the members of both boards that such agreement be approved by the stockholders.

The consolidated corporation will be known as Calumet & Arizona Mining Company. It will have an authorized capital of 1,000,000 shares of a par value of $20 a share.

Each person holding stock in present Calumet and Arizona Mining Company will receive one share of the consolidated company for each share held in the present company and each person holding stock of New Cornelia Copper Company will receive one share of the consolidated company for each 2.85 shares of the present company.

The first board of directors of the consolidated company will consist of all the members of the present companies.

When all stock of present companies is exchanged, the consolidated corporation will have outstanding 848,857 and will have in the treasury 157,143 for future expansion.

George Ruppe has been named a director of the Calumet and Arizona Mining Company to fill a vacancy on the board caused by the death of the late Captain Thomas Hoatson.

Phelps Dodge C. & A. Settle With Carson

The Phelps Dodge Corporation and the Calumet and Arizona Mining Company have made a settlement with the Carson Investment Company for infringement on the patents of George C. Carson, Robert Hays Smith of the Carson Company, announced early in February.

The Phelps Dodge and Calumet and Arizona provided in the settlement for a license for future use by them of the Carson inventions in their furnaces. Settlements previously had been made by the United Verde and the Magma Copper companies in cases pending against them.

Carson, through his investment company, has suits for infringement and damages pending against the Anaconda Copper Mining Company, the American Smelting and Refining Company and other large mining companies.

President Approves New War Mineral Relief Legislation

The President has approved and made a law S. 1347, passed by Congress, permitting the courts to pass on questions of law involved in the settlement by the Interior Department of war mineral claims. Claimants will have until February 13, 1930, to file suits in the Supreme Court of the District of Columbia on the law questions involved, and the cases may be appealed to the District of Columbia Court of Appeals and the U. S. Supreme Court. The two principal questions which the courts are expected to pass on are whether claimants may recover for interest paid on borrowed capital and for losses in connection with the purchase of property in producing essential minerals at the request of the Government during the World War.

In reporting the bill to the House of Representatives early in February Representative Robsion, of Kentucky, chairman of the House Committee on Mines and Mining, stated that the complaint in hearings before the committee on this and other legislation on the subject "has been that the Secretary of the Interior has not correctly construed the law."

The bill was reported by the committee in the face of a report from Secretary of Interior West to the effect that the proposed legislation is "in conflict with the financial program of the President." The committee reported that Assistant Secretaries of the Interior Finney and Edwards did not object to the bill, but welcomed a construction of the law by the court. They believed that the department has correctly construed the law, but if the court decides that it has been in error, the department will be glad to be set right. Mr. Robsion stated that there is little controversy with reference to the findings of facts by the department, but that serious dissatisfaction and controversy had arisen over its decisions on the law questions. The committee did not consider that any large number of cases would be carried to the court under this act, but said it would enable these cases to be rapidly settled.

The new legislation does not enlarge the scope of existing war mineral legislation, nor does it permit the filing of new claims, but authorizes the court to pass upon questions of law to guide the department in further administration of the act.

Eagle-Picher Plans Improvements to Lead Smelters

Improvements to cost approximately $250,000 will be made at the Smelter Hill and Galena plants of the Eagle-Picher Lead Company, John A. Schaeffer, vice president in charge of plants, announced early in February.

Additional acreage has been purchased to the west of the Galena plant and improvements will be added that will double the capacity of the plant. The entire plant will be modernized and the manufacturing of pig lead of the company will be concentrated at that point.

The Joplin plant will become solely a lead fabricating plant. In addition the company will install a lead sheet rolling plant, which will make the property one of the most complete in the United States, capable of fabricating any of the numerous products of lead.

The Ontario, Okla., plant will be maintained for the manufacture of antimonial lead, as in the past. Several extensive improvements have recently been completed at that plant. A. J. Smith, for the past four years manager of the Ontario plant, has been transferred to the Chicago office of the company. He will be succeeded by James Doyle, chief chemist.

Thomas Hoatson, 68, well-known Michigan mining man, died at Phoenix, Ariz., February 1, following a long illness.

He was an organizer and vice president of the Calumet & Arizona Mining Company, New Cornelia Copper Company, Verde Central Mining Company, Keweenaw Copper Company and the Merchants' & Miners' Bank, Phoenix.

Bureau of Mines Appropriations for Next Fiscal Year

The appropriation bill, passed by Congress and recently approved by the President, gives the Bureau of Mines $2,-249,670, for the fiscal year beginning July 1, divided as follows:

Investigating mine accidents $422,000; salaries and general expenses $91,500; mining investigations in Alaska $11,160; operating mine rescue cars and stations $326,130; testing fuel $179,210; mineral mining investigations $144,220; oil, gas and oil shale investigations $232,000; mining experiment stations $205,450; buildings and grounds at Pittsburgh Station $82,200; investigation of potash deposits $100,000; economics of mineral industries $285,000; investigation and conservation of resources of helium bearing gas $75,000; helium production plants $95,800, with authority to make contracts up to $500,000 in connection with acquiring leases on helium lands; the bureau will also receive funds from the army and navy for the purchase of helium; continuation of revolving fund for operation of the Government fuel yard which furnishes coal to Federal agencies in this city.

Appropriations for the Bureau of Standards include the following: metallurgical research $51,000; investigation of mine scales and cars $13,400; investigation of clay products $49,000; industrial research $204,000; standardization of equipment $220,000.

Incorporate Allen Zinc Ore Sales Company

Articles of incorporation have been filed in Oklahoma for the Allen Zinc Ore Sales Agency by R. C. Allen, holder of contracts for the disposal of zinc concentrates of some 15 or 20 of the leading producers of the Tri-State district. At present the offices of the agency have been established in the Joplin National Bank Building, but will be moved to or near Picher, as soon as suitable quarters can be found, after which the new corporation will function.

Les McColgin, ore buyer for the American Zinc, Lead and Smelting Company, resigned that position to accept a position with the Allen Zinc Ores Sales Agency.

Kennecott to Increase Capital Stock

Stockholders of Kennecott Copper Company of New York approved the proposal to increase the authorized capital stock to 12,000,000 no-par shares from 5,000,000 no-par shares, and to split stock on a two-for-one basis by giving shareholders one additional share for each share held. At present there are 4,551,313 shares outstanding. Stockholders also approved a plan to increase the number of directors from 15 to 18.

Directors of the Kennecott Copper have announced the placing of the new shares on a $4 annual basis, equivalent to the $8 rate paid on the old issue prior to the two-for-one distribution. A quarterly dividend of $1 was declared, payable April 1 to holders of record March 1.

Metal Mine Ventilation Standards

The American Mining Congress has appointed C. W. Nicolson, of Joplin, Mo., general manager of the Childress Lead and Zinc Company, as chairman of the Metal Mine Ventilation Committee of its Standardization Division. The committee will formulate a standard code of metal mine ventilation practice. Mr. Nicolson's extensive experience particularly well fits him to take the leadership of this large and important committee, which is largely representative of the country geographically and its members being recognized leaders in the metal mining industry.

New Secretary for Copper Ass'n

The Board of Directors of the Copper & Brass Research Association at its January meeting elected Bertram Barrett Caddle as secretary, to succeed Mr. John Fellows Gowen, resigned. Mr. Caddle has been connected with the association as assistant to Mr. Willis, the manager, for seven years. He was born in Wheeling, W. Va., in 1887, and before coming to the association had an extensive newspaper experience, being connected with the editorial departments of the *Wheeling Intelligencer*, the *Wheeling News*, and the *Wheeling Register;* the *Cleveland Plain Dealer*, the *El Paso Times*, the *El Paso Herald*, the *Santa Fe New Mexican*, the *Albuquerque Herald* and the *New York Herald.*

B. B Caddle, newly - elected secretary of the Copper & Brass Research Association

Mr. Gowen, who served two years as secretary, resigned to take a position on the staff of Lehman Bros., bankers, of No. 16 William Street.

Geologic Map of New Mexico

The first large colored geologic map of the State of New Mexico has been issued by the U. S. Geological Survey. It may be purchased for $1.50 a copy. It shows the geologic formations, topographic features, and mineral resources in 17 colors, with 22 separate colors and pattern distinctions. In the northwestern part of the San Juan Basin are the oil-bearing domes that are now being explored.

Hess on Trip to Far East

Frank L. Hess, chief engineer of the Rare Metals and Non-Metals Division of the United States Bureau of Mines, is sailing from San Francisco on March 15 on an extensive trip which will include parts of China, the Malay Peninsula, India, Russia, Norway, Sweden, Germany, Italy and England. Mr. Hess will be on leave of absence from the Bureau and expects to be gone most of the year, making various examinations of ore deposits, largely for his own interest.

Walter S. Harper Dies

Walter S. Harper, assistant secretary and treasurer of the Inspiration Consolidated Copper Company, died from heart disease at his home, 125 Rutland Road, Brooklyn, New York, recently, in his 61st year.

Mr. Harper was a well-known mining man, having been identified with the industry ever since his arrival in this country from Scotland as a young man. He had been with the Inspiration Consolidated Company for over 20 years and was also interested in a number of other companies, including the Ahumada Lead Company, the Erupcion Mining Company, Greene Cananea Copper Company and a number of other well-known metal mining enterprises.

The Internal Revenue Bureau has issued Income Tax Regulations No. 74 under the 1928 revenue law. They will apply to the taxable year 1928 and succeeding years. Income, war profits and excess profits taxes for years preceding 1928 will not be affected by the new regulations, but will be subject to the applicable provisions of prior revenue acts, except as they are modified by titles 3, 4 and 5, of the 1928 act or by legislation subsequent to that act.

Directors of the Anaconda Copper Mining Company declared a quarterly dividend of $1.75 a share on common stock, placing the issue on a $7 annual basis, against $6 previously. The dividend is payable May 20 to stock of record March 29.

High Price for Copper Brings Wage Increase for Miners

Wage rates for miners in the important copper mining districts of the country have again been boosted as a direct result of the continued improvement in the price of copper, which by the end of February had soared to 19¼ cents a pound for both domestic and foreign delivery.

On February 4, copper mining companies in the Butte district of Montana announced that, effective immediately, the wages of all employes on the pay roll would be advanced 25 cents a day over the scale in force. Approximately 18,000 men employed by the Anaconda Copper Mining Company, Butte & Superior Company, and the East Butte Copper Mining Company benefit by the increase, which makes the present basic pay of miners $5.50 per day and will remain in effect so long as the domestic price of copper is 17 cents or more per pound. This increase constitutes the second raise awarded employes by the Butte operators since the improvement in the price of the red metal last fall. On October 1 a wage increase of 50 cents a day, affecting all daily pay roll employes, was announced. At that time copper was selling at 15 cents a pound.

The Phelps Dodge Corporation, Copper Queen Branch, Calumet & Arizona Mining Company and the Shattuck-Denn Mining Company, in the Bisbee district, Arizona, on February 5 announced an increase of 5 percent, based on the wage scale in effect prior to October 1, 1928, the increase to be effective February 1. The advance will be maintained as long as the price of copper averages 17 cents a pound or over. An adjustment in the rates of salaried employes was also made, it was announced. The increase is the second since the price of copper began to advance. The first was 10 percent, made last October.

On February 11, a general announcement of wage increases, benefiting upwards of 7,500 employes, effective March 1, was made by mining companies in the Michigan copper country. In the case of Calumet & Hecla and Isle Royale there was a general increase of 10 percent. The Copper Range increase was in amounts varying from 7½ to 10 percent, the larger percentage applying to the lower rates, making it a graduated scale. Both Mohawk and Quincy announced an increase, effective March 1. The Michigan Smelter put a wage increase similar to that of Copper Range into effect.

Effective February 15, the Utah Copper Company, in Bingham Canyon, Utah, increased the wages of approximately 3,500 men, the advance amounting to 20 cents a day for all receiving less than $4.50, and 25 cents for all receiving more than that amount a day. The American Smelting & Refining Company increased its scale 25 cents a day at the Murray smelter, and 20 and 25 cents at the Garfield smleter. International Smelting, Refining & Mining also increased wages at their plants 25 cents a day.

Evans-Wallower Lead to Acquire Eastern Electrolytic Zinc, Inc.

Announcement was made early in February by the Evans-Wallower Lead Company of negotiations leading to acquisition of the interests of Eastern Electrolytic Zinc, Inc., in the Tainton Process rights for the production of superfine electrolytic zinc, under which the Evans-Wallower Lead Company will acquire broad, underlying rights now owned by the eastern company in the southwest portion of the United States, the Trit-State area and the territory east of the Mississippi river. It was stated that the Evans-Wallower Company would acquire these rights in exchange for stock, the transaction to be approved by ratification of the directors and stockholders of each company.

The statement was issued by Edgar Z. Wallower, president of the Evans-Wallower, and Victor Rakowsky, president of Eastern Electrolytic Zinc., Inc., that the transaction will take the form of a coalition of interests of Evans-Wallower and Eastern Electrolytic Zinc, Inc. U. C. Tainton, who developed the zinc process now in operation at a plant in Kellogg, Idaho; Rakowsky and William McClellan, vice president of Stone and Webster Company, will become members of the board of the Evans-Wallower.

Frederick W. Bradley, the new president of the American Institute of Mining and Metallurgical Engineers

The Evans-Wallower is now constructing an electrolytic zinc plant under Tainton process rights at East St. Louis, Ill., which plant will be completed about July 1.

Electrolytic Plant for Eastern Canada

Ventures, Ltd., and Consolidated Mining Company are cooperating in the establishment of a copper refinery and electrolytic zinc plant to be erected in Eastern Canada, according to a joint announcement over the signatures of Thayer Lindsley and J. J. Warren, president of the two companies. The refinery will treat the products of the mines of the two corporations and is prepared to accept any customs business offered. The official statement is as follows:

"An arrangement has been completed between Ventures, Ltd., and the Consolidated Mining & Smelting Company, Ltd., for the immediate erection of a copper refinery and an electrolytic zinc reduction works in Eastern Canada, to handle the products of the mines controlled by the two corporations and any customs business offered. The Normanda Company were offered participation, but apparently have declined. The locality where the plants will be established, has been decided on, but the site has not yet been purchased. The plants will be designed and built by the metallurgical staff of the Consolidated Company. The copper refinery will be somewhat larger than the Tadanac plant of the Consolidated. The zinc reduction works will be smaller than the Tadanac one. Both will be laid out so as to permit of extension being readily and economically made."

Great Northern to Start Iron Ore Explorations

Exploration of the 50,000 acres near Aitkin, Minn., on which options were recently acquired by Great Northern Iron Ore Properties, will be started as soon as weather conditions will permit.

A number of drills are to be operated on the tract, which lies largely to the north of Aitkin and sufficiently far away to cause no upset of affairs in the village by operations within the limits as was the case on the Mesaba range.

H. J. Kruse, a mining engineer, has been largely instrumental in securing the options and will direct the drilling. Test pits are said to have proven that ore exists and the drilling now proposed is to determine both quality and quantity as to the larger area.

Phelps Dodge Corporation stockholders voted February 25 to change capital stock to 2,000,000 shares, $25 par, from 500,000 shares, $100 par.

Mining Institute Held at College of Mines, University of Washington

Registration of 120 persons and an average attendance of 50 marked the sessions of the Mining Institute of the College of Mines, University of Washington, held during the week of January 21 to 26. In addition to those registered for the courses given in the daytime many others attended the illustrated lectures in the evenings. The renewed activity in mining was reflected by the large attendance and by the interest shown in the various programs of the institute. Mining men and prospectors, representing every phase of the industry, business and professional men who make contact with mining, and a scattering of persons who wished to hear special subjects attended the institute. It was noticeable that a large number of men came from points outside the city of Seattle to attend the meetings.

The program extending over the week consisted of a series of lectures given by members of the faculty of the College of Mines and by outside engineers who presented subjects covered by their particular fields of interest. Laboratory demonstrations, a program of motion pictures, a trip to the Tacoma smelter, a luncheon given by the students' Mining Society, and a joint session with the North Pacific section of the American Institute of Mining and Metallurgical Engineers supplemented the formal lectures.

The special speakers and the subjects of their addresses follow:

George Watkin Evans, consulting engineer, Seattle—"The Coal Fields of the Pacific Slope."

A. H. Richards, manager of the Tacoma smelter—"The Purchasing of Ores and the Metallurgical Processes Employed at the Tacoma Smelter."

Dale L. Pitt, manager of the Premier mine, British Columbia—"Mining from the Operator's Standpoint."

Robert T. Banks, of the Sullivan Machinery Company, Spokane—"Diamond Drilling for Prospecting and for Oil Production."

L. B. Slichter, geophysicist, Physical Exploration Corporation, Madison, Wis.—"Methods of Electrical Prospecting."

Ward Royce, of the Ingersoll-Rand Company, Seattle—"Equipment for a Small Mine."

R. E. Murphy, of the Du Pont Company, Seattle—"The Use of Explosives in Mining Operations."

W. D. Shannon, northwest manager Stone and Webster Corporation, Seattle — "Steam-Generated Power versus Hydro-Electric Power Development."

Charles L. Bretland, assayer, U. S. Assay Office, Seattle—"The Assay and Purchase of Gold Bullion."

R. P. Leonard, of the Gardner-Denver Company, Seattle—"Rock Drilling."

H. F. Yancey, Northwest Experiment Station, U. S. Bureau of Mines—"The Work of the U. S. Bureau of Mines."

John Schoning, foreman miner, U. S. Bureau of Mines—"First-aid and Rescue Methods in Mining."

Members of the staff of the College of Mines lectured on the following topics:

Dean Milnor Roberts—"Metal Mining Methods and Costs," "Ore Dressing," "The Mineral Resources of the Pacific Northwest."

Prof. Joseph Daniels—"Recent Developments in Low Temperature Carbonization Processes and Improved Methods of Utilization of Coal," "Iron Ore Resources of the Pacific Northwest."

Prof. C. R. Corey—"Metallurgy of the Common Metals," "The Significance of Metallography in Metallurgy."

Prof. Hewitt Wilson—"The Origin, Occurrence, and Properties of Clays and Other Nonmetallic Ceramic Materials," "The Testing of Clays and Clay Products, Such as Brick and Tile, Terra Cotta, Fire Brick, Pottery and Enameled Wares."

Dean Henry Landes—"Geological Aspects of Prospecting for Coal."

Prof. George E. Goodspeed—"Petrology as Applied to Mining."

Prof. J. Grattan O'Bryan—"The Significance of Recent Decisions on Leasing of Government Oil Lands."

Consumption of Copper

Copper annually consumed by two major forms of transportation, automobiles and railroads, now reaches the large total of 340,000,000 pounds, according to surveys completed by the Copper and Brass Research Association.

Estimates of the association indicate a total of approximately 1,786,000,000 pounds of copper now in use in passenger cars of American manufacture and in the railroad systems of the Nation today. About 250,000,000 pounds of copper are consumed by the automobile industry every year, the association states.

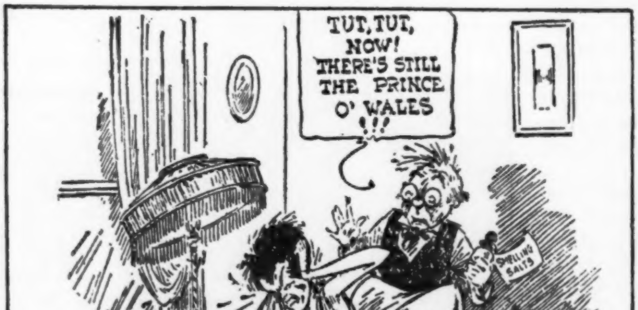
"There are about 21,000,000 registered passenger cars in the United States. The amount of copper now in use in this class of cars alone totals approximately 936,000,000 pounds.

"The new Ford Model 'A' uses 5 pounds more copper than the old Model 'T'. This is an increase of 20 percent. Since the Ford car represented 47 percent of all registered passenger cars in the United States at the time the model was changed a substantial increase in the future automotive consumption of copper may be expected."

In discussing the use of copper on railroads, the association estimates that between 75,000,000 and 100,000,000 pounds of the metal are consumed annually by this form of transportation. More than 850,000,000 pounds of copper and its allows are now in use on American railroads, it declares, adding that "the increasing importance of electrification promises an even larger consumption of copper in the future."

Present electrification represents about 100,000,000 pounds of copper and covers only a small portion of existing track mileage. The new electrification programs of the Pennsylvania and other roads are expected to add approximately 90,000,000 pounds of copper to these requirements.

The 60,000 locomotives in service in the United States today contain 260,000,000 pounds of copper. Nearly 62,000 passenger and Pullman cars account for 83,000,000 pounds of the metal. There are 240,000,000 pounds of copper in the cars, num-



—*New York Telegram*

There, Little Girl, Don't Cry!

bering 2,400,000, that haul the Nation's freight.

"Rolling stock does not account for all the copper, brass and bronze used by railroads. Automatic signals require 25,000,000 pounds of the everlasting metals while shops and power plants have copper in service to the extent of 40,000,000 pounds. The magnitude of this latter figure is accounted for, in part, by the increasing use of electrical machinery in railroad shops. The private telegraph and telephone systems contain 75,000,000 pounds of copper. Finally, there are about 20,000,000 pounds of the metal in railroad buildings throughout the United States."

Ontario to Study Iron Ore Deposits

Immediate steps are to be taken by the Ontario government to investigate the possibilities of the huge iron ore deposits along the north shore of Lake Superior.

Professor O. W. Ellis, one of the leading metallurgists in the United States, who has been engaged by the Ontario Research foundation to conduct its work in metals, will undertake the investigation. This will entail expensive laboratory tests, aimed at lowering the present costs of development.

Anaconda Subsidiary to Take Over Two Plants

The Anaconda Copper Mining Company has announced that it has organized a subsidiary known as the Anaconda Wire and Cable Company, a Delaware corporation.

The new company will take over rod and wire mills of the parent concern at Great Falls, Mont., and the wire mills of the American Brass Company, also a subsidiary, at Kenosha, Wis.

In addition, an offer of stock in the new company will be made for the business and assets of the Inland Wire and Cable Company, Sycamore, Ill.

Noranda Mines to Build Copper and Zinc Refineries

Application has been made for the incorporation of a company that will construct a copper refinery in Eastern Canada, it was announced February 5 by J. Y. Murdock, president of Noranda Mines, Ltd.

The British Metal Corporation, London, England, and the Nichols Copper Company, of New York, are associated with Noranda in the project.

Later in the month Mr. Murdock stated that Noranda would soon construct a new refinery for zinc. He said:

"We are soon going to construct a copper refinery in the province of Quebec and by its side a refinery for zinc, because of the interesting zinc discoveries made on Noranda properties in Amulet, Abana, Aldermac, and even Gaspesia." The new refineries will be built near either Montreal or Quebec.

World Zinc Production Analyzed

W. R. Ingalls, director of American Bureau of Metal Statistics and leading authority on zinc, in analyzing world zinc output of 1,563,324 short tons for 1928, places electrolytic zinc output of the world for last year at 329,312 tons compared with 253,267 tons in 1927 and zinc from distillation at 1,234,012 tons in 1928 compared with 1,211,803 tons in preceding year.

The following shows production in short tons as classified by him:

	1928	1927
United States		
Total	607,195	485,363
Electrolytic	160,000	112,629
Distilled	447,195	485,363
Elsewhere:		
Total	956,129	867,078
Electrolytic	169,312	140,638
Distilled	786,817	726,440
Combined:		
Electrolytic	329,312	253,267
Distilled	1,234,012	1,211,803
Total	1,563,324	1,465,070

All existing blasting and tonnage records for Lake Superior district, (Michigan) open pit mining will be broken in May of this year if plans now under way at the Volunteer property, near Palmer, are carried out. Between 60 and 80 tons of powder will be used to break down what is estimated will be more than 400,000 tons of ore. A smaller blast will move between 90 and 100 tons of ore. Both of these blasts will be set off early in May, just before the opening of the lake shipping season.

Thomas F. Cole and C. F. Wittenberg recently exercised their option on the Schubert-Coop property at Manhattan, Nev., according to word received from Tonopah. The price is said to be $100,000, with a first payment of $10,000.

A very wide orebody carrying from $15 to $20 gold a ton was recently discovered on the surface and a considerable tonnage has already been treated in the War Eagle mill.

Silver Suit Argued—Decision Early in March

Argument was heard February 8 by the Court of Appeals of the District of Columbia on the suit of the American Silver Producers Association to require the Government to purchase 15,000,000 ounces of silver at $1 per ounce to complete purchases under the Pittman Act. The purchases would replace Pittman silver allocated for subsidiary coinage, but subsequently revoked. Justice Stafford, of the District Supreme Court, last spring decided that the association did not have a sufficient interest to bring the suit, but did not pass on the questions involved in the litigation. The recent argument was on an appeal from his decision and covered all of the issues. The case was handled for the association by former Senator C. S. Thomas, of Colorado, and by District Attorney Leo A. Rover for the Government. The court is not expected to make its decision before March 5. In any event, it will probably be further appealed by the losing side to the U. S. Supreme Court.

Patents to Land Containing Minerals at Depth

Indorsement of H. R. 15919, introduced by Representative Douglas (Dem., Ariz.) and passed by the House of Representatives, authorizing patents to 320-acre tracts of land containing minerals at depth without showing a discovery, was given before the Senate Public Lands Committee recently by The American Mining Congress through M. W. Kriegh, chief of its mineral land division. Mr. Kriegh said the legislation would revive and stimulate prospecting and remove handicaps which have been created by the homestead laws under which prospectors have been excluded from large areas.

"The present law requires actual discovery of minerals in place in order to prove a patent for a lode claim," Mr. Kriegh said. "This law was sufficient so long as discoveries were made of outcrops on the surface. But mines are no longer discovered in this manner. They are now located and discovered at unheard-of depths, in locations where the existence of the mineral could be expected only as the result of underground exploration, which disclosed geological indications that pointed to the existence of ore bodies. By scientific methods of prospecting now being developed, it will be possible to locate bodies of minerals at depths which would make discovery as defined by our present laws impossible, and yet no prospector or operator

would be justified in raising the funds and incurring the expense necessary to open up a body of ore at great depth below the surface, except under legal provisions which would insure to him the ownership of that ore body when finally developed."

Ceramic Associations Meet—Exposition a Feature

The American Ceramic Society held its thirty-first annual meeting in Chicago the week of February 4, concurrently with meetings of the American Face Brick Association, American Refractories Institute, the Common Brick Manufacturers' Association, the Canadian National Clay Products Association, the Grinding Wheel Manufacturers' Association, Illinois Clay Products Association, National Brick Manufacturers' Association and the Structural Tile Association.

Probably the most interesting feature of the meeting, which attracted close to 2,500 delegates, was the ceramic products exposition which occupied the entire basement floor of the Stevens Hotel and which was the first of its kind ever attempted in the United States.

Susquehanna Collieries Company Official Dies

Robert A. Quin, vice president of the Susquehanna Collieries Company, at Wilkes-Barre, Pa., died January 22 of injuries received a week previous when it is believed he slipped and fell while walking, fracturing his skull. Mr. Quin was born in Pottsville, January 17, 1864. His connection with Susquehanna Collieries Company had its inception when he was appointed superintendent of Shipman Coal Company at Shamokin in January, 1898. In April, 1899, he was appointed superintendent of William Penn colliery of Susquehanna Co., Shamokin, in which position he remained until January 1, 1901, when he was transferred to take charge of the Mineral Railroad & Mining Company, also a part of the Susquehanna holdings. In recognition of his outstanding ability, Susquehanna Collieries Company appointed him manager in 1903 of all the collieries of Susquehanna and Lytle Coal Companies, which position he held until last August, when the company promoted him to vice presidency of all its holdings.

Mr. Quin was a member of The American Mining Congress, the Engineers' Society of Northeastern Pennsylvania, and American Institute of Mining and Metallurgical Engineers.

The Pennsylvania Geological Survey has issued a report on the mineral resources of the Pittsburgh quadrangle.

S. Pemberton Hutchinson Dies

S. Pemberton Hutchinson, of Philadelphia, president of the Westmoreland Coal Company, and a director of the American Mining Congress, died Saturday, February 16, of pneumonia, in the Bryn Mawr Hospital in Philadelphia, at the age of 67.

Mr. Hutchinson was in his office Monday, the eleventh, and on Tuesday, Lincoln's Birthday, he passed the day at his home, apparently in his usual health. He was stricken Wednesday, however, and was removed to the hospital.

Mr. Hutchinson was born in Philadelphia, a son of Sydney Pemberton and Agnes (Wharton) Hutchinson, and was educated at St. Paul's School, Concord, N. H., and the University of Pennsylvania. Following his graduation in 1881 he entered the employ of the Pennsylvania Railroad as a rodman in the engineering corps. His promotion was rapid until he became assistant general agent for the railroad in New York. During this time he became associated with Phelps, Dodge & Co., in its railroad enterprises.

In 1905 Mr. Hutchinson resigned as an official of the Baltimore and Ohio Railroad to become a member of the banking firm of Cramp, Mitchell & Shober, in Philadelphia. Besides his position at the head of the Westmoreland Coal Company, he was a director of the Pennsylvania Company, trustee of the Penn Mutual Life Insurance Company, manager of the Philadelphia Saving Fund Society and a director of the Stonega Coal & Coke Company and was associated with many other companies and financial institutions.

President Wilson appointed Mr. Hutchinson as a member of the National Industrial Conference at Washington in 1919, and he took an active part in the formation of conciliatory plans for settling controversies between labor and capital.

In April, 1887, Mr. Hutchinson married Miss Amy Lewis, daughter of John T. Lewis, of Philadelphia. She survives with four children: S. Pemberton Hutchinson, Jr., Mrs. Henry S. Drinker, Jr., and Mrs. Joseph T. Thayer, of Philadelphia, and Mrs. George W. Martin, of New York.

One brother and three sisters also survive. They are Sydney E. Hutchinson, Mrs. William S. Ellis and Mrs. J. Conyngham Stevens, of Philadelphia, and Mrs. Samuel L. Shober, of Atlantic City.

Rocky Mt. Coal Institute To Meet in Salt Lake City, March 11-13

Hundreds of mining engineers and coal operators from the four principal western coal states, Utah, Colorado, Wyoming and New Mexico, will gather in Salt Lake City, March 11, 12, and 13, for the twenty-seventh annual meeting of the Rocky Mountain Coal Mining institute.

The 1929 meeting will be the first held in Utah in many years, all of the recent sessions having been in Colorado. The coming meeting will be held jointly with the Utah section of the American Institute of Mining and Metallurgical Engineers, but the program will be confined wholly to the coal industry.

The program will fall into two divisions, namely, safety and mechanization. Dan Harrington, chief of the safety division of the United States Bureau of Mines of Washington, D. C., will preside over the sessions dealing with promoting safety in mine operations. G. B. Southward, mechanization engineer of the American Mining Congress of Washington, D. C., will preside at one of the sessions which will deal with mechanization. Mr. Southward will also speak on the development of mechanization in the United States, and will probably outline the nation-wide mechanization program which is being sponsored by the American Mining Congress.

Executives of the United States Fuel Company of Utah, the Union Pacific Coal Company of Wyoming, the Colorado Fuel and Iron Company of Colorado and the Phelps Dodge Corporation of New Mexico will be among the principal speakers at the meeting. Representatives of other companies who will take part in the program will be named later.

The meeting will be held under the direction of Otto Herres, general manager of the United States Fuel Company, president of the institute, and John M. Boutwell, chairman of the Utah section of the American Institute of Mining and Metallurgical Engineers.

George A. Murphy, general superintendent of the Spring Canyon Coal Company of Utah, is chairman of the program committee. George B. Pryde, vice president and general manager of the Union Pacific Coal Company, is representing the program committee in Wyoming, and Benedict Shubart, secretary of the coal institute, is handling the Colorado part of the program.

The meeting will end with election of officers for 1929-1930.

Mechanization Work Outlined Before College Engineering Societies

The work of the American Mining Congress in promoting mechanization in mines was outlined by Dr. Henry Mace Payne, its consulting engineer, in an address recently at Easton, Pa., before the engineering societies of Lehigh University and Lafayette College, at which members of the engineering association of the Lehigh Valley were guests. Dr. Payne urged the cooperation of engineers in the work of the National Committee on Mechanized Mining recently appointed by the Mining Congress which is conducting a five-year survey covering mechanization in coal mines. Dr. Payne stated that mechanization in coal mining is increasing at the rate of 50 percent a year and that present mechanization equipment is capable of producing 30,000,000 tons of coal per year. By mechanization, Dr. Payne stated that safety in the mine is increased by 50 percent and that loading costs are from 7 to 30 cents per ton less.

Coal Mine Drainage Standards

The American Mining Congress has appointed Walter E. Housman, of Scottdale, Pa., research engineer of the H. C. Frick Coke Company, as chairman of the Coal Mine Drainage Committee of its National Standardization Division. His research studies in acid resisting alloys for pump equipment and his wide experience with drainage problems make Mr. Housman eminently well fitted to lead the work of revising the existing mine drainage standard. This standard was approved as a Tentative American Standard on June 2, 1927, by the American Standards Association. Many of the important recommendations are undergoing revision in the light of improved practice in coal-mine drainage. The large and representative committee of which Mr. Housman is chairman will undertake revision in the near future.

Union Mechanical Loading Agreements by States Are Summarized

Mechanization is being advanced under new agreements of coal mining companies with the union, according to a report of the Department of Labor which gives a summary of the new contracts.

"The right of the coal operators to install mechanical loaders and conveyors is recognized," says the report. The agreements provide for a reduction in the basic day wage rate that existed under the former general union agreement. The day wage scale will be effective until a tonnage rate is agreed upon. The report reviews the agreements adopted for mines in Illinois, Indiana, Iowa, Kansas, Michigan, Montana, Ohio, and Wyoming.

A summary of the agreements affecting mechanization is as follows:

Illinois—The right of companies to install mechanical loaders and conveyors of all types is recognized. To establish a tonnage rate for loading and conveying coal by machine, a commission of two operators and two miners is authorized to fix a rate after studying conditions surrounding the use of such machinery in Illinois. Daily rates are to prevail until the commission reports. Should operators who plan to install loaders and conveyors feel that conditions will not permit payment of the fixed day rate, they may ask the Commission to establish reduced rates. The Commission may authorize temporary rates until its final decision on a general tonnage rate.

Indiana—The right of companies to install mechanical loading machines and conveyors of all types is recognized, with a daily wage rate.

Iowa—Daily rates are provided for workers on mining machines and loaders.

Michigan—The agreement provides for a 19 percent wage reduction on all classes of labor except for mechanical loading, which carries the old rate.

Montana—Day rates are provided for operation of mechanical loaders and conveyors until tonnage rates or a combination of day and tonnage rates are agreed upon.

Ohio—Temporary daily wage for machine coal loaders and conveyors until a tonnage rate is agreed upon.

The agreement with the Central Ohio Coal Operators Association provides for an investigation and report in February, 1930, by a commission of three operators and three miners, covering the relationship between conditions in mines in Ohio, West Virginia, Virginia and Kentucky; for readjustment of discriminatory freight rates against Ohio coal; to protect the coal industry against adverse legislation and to promote legislation helpful to it; and to work for conditions which will bring the industry a fair return and advance the living standards of the miners.

Anthracite Research Under Way

Scientific and mechanical research in the anthracite industry is being conducted by the Anthracite Operators' Conference under the direction of Daniel T. Pierce, of New York, vice chairman. The scientific work will be undertaken by Dr. Horace C. Porter, chemical engineer of Philadelphia, covering the preparation, classification, utilization and combustion of anthracite. R. V. Frost will conduct mechanical research and development work at the Frost laboratories at Norristown, Pa., including the testing and improvement of devices for mechanical burning, ash-handling and heat control.

H. A. McAllister Heads Logan Operators

The annual meeting of the Logan Coal Operators' Association was held recently at Logan, W. Va. The following officers were elected: President, H. A. McAllister, Hutchinson Coal Co., Logan, W. Va.; vice president, W. T. Jones, general superintendent, Guyan Eagle Coal Co., Amherstdale, W. Va.; treasurer, Arthur Downing, general manager, Monitor Coal & Coke Co., Wilkinson, W. Va.

Probe Asked of I. C. C. on Wet-coal Rates

The Interstate Commerce Commission was asked February 18 by Representative John J. Douglas, Democrat, Massachusetts, to investigate the practice of railroads serving the anthracite coal regions of Pennsylvania in giving reductions in freight rates to mines shipping wet or "washed" coal while allowing no such reduction to mines shipping dry coal.

The practice is uneconomic, Douglas declared in a brief filed with the commission, and, in his opinion, is unlawful.

The coal producer, Douglas said in the brief, washes his coal to bring it up to required grades "and believes he is being benefited, as the washing increases the weights returned to him by the railroad company," while in reality "it is a detriment to him as it reduces the heat units in the coal, which narrows his market."

A. G. Southworth and R. W. Phillips, of the audit review division of the Internal Revenue Bureau, contribute an article on "Anthracite Coal and the Income Tax" in the January issue of *Internal Revenue News*. They state that income tax returns on Pennsylvania anthracite are made by 1,800 companies and individuals. The report refers to difficulties in passing on capital and expense items of large anthracite operating companies, and also to depreciation allowances.

Hilton Heads Hazard Operators Exchange

About 300 members and guests of the Hazard Coal Operators' Exchange gathered at the annual banquet held Friday evening, February 1, at the Lafayette Hotel, Lexington, Ky. A. L. Allais was the toastmaster. President Whiteford Dale, of the Louisville & Nashville Railroad, made a plea to operators to oppose any legislative proposal for the bituminous industry and denounced the Watson bill. He said some actions of the Interstate Commerce Commission were harmful both to railroads and the public. Other speakers were James L. Davidson, secretary, Alabama Fuel Association, Birmingham, Ala.; Judge H. B. Lindsay, Knoxville, Tenn.; Dr. Henry Mace Payne, American Mining Congress, Washington, D. C.; Judge Koyland Baggott, Dayton, Ohio, and C. B. Huntress, assistant to the executive secretary of the National.

At the business meeting of the Hazard Association, Emmet Howe told of trade practice and safety work of his organization and Robert Tway, president, R. C. Tway Coal Company, Louisville, discussed trade practice movement now under way in West Kentucky and being organized in the Harlan association. Favorable expression was given to establishment of safety station at Hazard by way of additional equipment and provision for maintenance cost. The matter was referred to committee. Several other committees were authorized, including one to develop trade practice plan. A resolution was adopted to support the National relative any action which might be taken for a tariff on crude oil and its products.

The following officers were elected: President, J. B. Hilton, vice president, Columbus Mining Company, Chicago; vice president, W. E. Davis, president, Midland Mining Company, Lexington; treasurer, H. E. Bullock, president, Carrs Fork Coal Company, Lexington, and secretary, J. E. Johnson, Lexington.

The new Executive Committee is composed of: A. L. Allais, Chicago, Ill.; James Bonnyman, P. H. Burlingham, Calvin Holmes, Dan Pritchard, Cincinnati, Ohio; George P. Fitz, Hazard, Ky.; J. H. Bowling, W. J. Brown, Jr., Hugh Buford, W. S. Dudley, H. K. English, John P. Gorman, T. W. Havely, E. C. Perkins, Carel Robinson, C. Reginald Ryley, Lexington, Ky.; Henry LaViers, Paintsville, Ky.; W. F. Mandt, Carbon Glow, Ky., and J. B. Allen, Allock, Ky.

Two subjects of more than ordinary interest will be studied by committees of the Hazard Operators' Exchange. First is group purchasing of mine equipment, supplies and commissary merchandise.

The second subject, a central coal cleaning plant, was discussed at length at the meeting. Secretary James L. Davidson, of the Alabama Mining Institute, told of the progress in coal washing made by Alabama operators and of their present study, at the University of Alabama, in cooperation with representatives of the U. S. Bureau of Mines, looking to improved methods. Of the output of Alabama mines, more than half the tonnage, or about 12,000,000 tons, is washed.

B. M. Clark Again Heads Central Pennsylvania Association

At the annual meeting of the Central Pennsylvania Coal Producers' Association, held at Altoona on February 15, B. M. Clark, president of the Rochester & Pittsburgh Coal Company, of Indiana, Pa., was reelected president, and G. Webb Shillingford, president, Empire Coal Mining Company, New York City, vice president, and Charles O'Neill secretary.

—The Knickerbocker Press.

The Hallelujah Chorus

—Philadelphia Ledger.

Boys Will Be Boys

Eastern Ohio Association Holds Annual Meeting

The annual meeting of the Eastern Ohio Coal Operators Association was held in Cleveland recently. W. L. Robison, vice president, Youghiogheny & Ohio Coal Company, was chosen to head the association as president for the ensuing year. Other officers are: Vice president, R. L. Ireland, Jr., general manager, Wheeling & Lake Erie Coal Mining Company; treasurer, Elliott Willard, treasurer United States Coal Company, and D. F. Hurd, secretary.

Comparative Figures on Bituminous Coal Exports for 1927 and 1928

According to the Coal Section, Bureau of Foreign and Domestic Commerce, exports of bituminous coal in 1928 and 1927 were 14,432,377 and 16,081,904 tons, respectively, of which Canada took 12,461,092 and 13,030,622 tons, respectively. A comparison of the trade of the leading districts of exportation indicates that in 1928 and 1927 Philadelphia shipped 103,824 and 303,581 tons; Maryland, 178,837 and 350,327 tons; Virginia, 1,657,849 and 2,311,278 tons; South Carolina, 82,758 and 205,901 tons; the Gulf districts, 27,998 and 29,501 tons, and all other districts (Canada, Mexico and Pacific Coast districts), 12,381,111 and 12,881,316 tons, respectively.

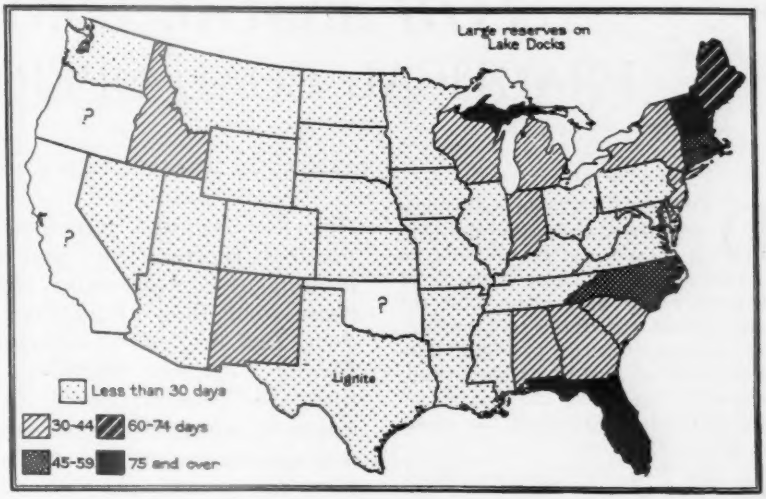
Coal Mine Ventilation Standards

The Standardization Division of The American Mining Congress has issued a proposed standard for mine ventilation practice for final consideration of the members of the committee who drew it.

The committee, which is representative of every coal-mining district in the country, has been working this code during the past eight months under the leadership of A. W. Hesse, chief mining engineer of the Buckeye Coal Company of Nemacolin, Pa.

Mining Investigation Commission Appointed in Illinois

Governor Louis L. Emmerson, of Illinois, has appointed a commission to investigate laws and changes in laws in the state affecting the coal mining industry in Illinois. It is known as the Illinois Mining Investigation Commission and its members will hold office for two years. The commission is composed of three operators, three miners, and three disinterested parties. The operators are: Rice Miller, president, Lincoln Coal Corporation, Chicago; George Campbell, assistant to the president, Old Ben Coal Corporation, West Frankfort, and L. D. Smith, vice president, Chicago, Wilmington & Franklin Coal Company, Chicago.



Days' supply of bituminous coal on hand at general industrial plants (other than steel and coke works), January 1, 1929

At the rate of consumption prevailing in November and December, the industrial plants reporting had coal enough to last 33 days on January 1, the smallest reserve reported at any time since April 1, 1926. Over most of the country, the stocks averaged less than 30 days. Heavier reserves were reported from the Southeast, New England, and some other northern states.

Survey of Commercial Stocks of Coal

Commercial stocks of bituminous coal used largely for industrial purposes amounted to 41,800,000 tons on January 1, 1929, according to a survey just completed by the Department of Commerce, through the United States Bureau of Mines. In comparison with the amount reported on October 1, the date of the last previous survey, this is an increase of 700,000 tons.

Exports during the fourth quarter of 1928 averaged 359,000 tons a week against 399,000 tons in the previous quarter and 273,000 tons during the fourth quarter of 1927. The weekly rate of home consumption during the fourth quarter averaged 10,416,000 tons, slightly more than in the corresponding period a year ago.

In addition to the stocks in the hands of consumers, there were 8,317,603 tons of bituminous coal on the docks of Lakes Superior and Michigan on January 1, 1929, in comparison with 8,409,453 tons on January 1, 1928.

The stocks of domestic anthracite held by the coal merchants reporting are close to the average for this season in recent years.

West Virginia Maintains Lead In Bituminous Coal Production

West Virginia maintained its rank during 1928 as the leading bituminous coal producing state in the country, according to a statistical compilation made by the United States Bureau of Mines. Production of coal in West Virginia in 1928 amounted to 132,600,000 tons as compared with the Pennsylvania bituminous output of 124,720,000 tons. West Virginia exceeded Pennsylvania in bituminous production for the first time in 1927 with an output 9 percent greater than that of the latter state. Last year West Virginia's production was slightly over 6 percent more than Pennsylvania's. Although yielding first place in bituminous coal production to West Virginia, Pennsylvania, with a 1928 output of 76,734,000 tons of anthracite, is still far in the lead as a producer of all classes of coal.

The 1928 coal production figures show that Kentucky, with an output of 63,255,000 tons, ranked third among the states, while Illinois, with an output of 55,640,000 tons, was fourth.

For the country as a whole, production of bituminous coal in 1928 is estimated at 492,755,000 net tons, as compared with 517,763,000 tons in the previous year. This is a decrease of nearly 5 percent. While all the eastern states shared in this decrease, several of the states in the middle west in which mines were inoperative last year showed an increase over 1927.

Production of Pennsylvania anthracite also declined in 1928. The total output last year was 3,362,000 tons less than in 1927. With the exception of the strike years of 1925 and 1922, this is the smallest tonnage produced by the anthracite fields since 1906.

SIXTH ANNUAL CONVENTION
PRACTICAL COAL OPERATING MEN

American Mining Congress announces program for annual meeting of coal operating officials—Paul Weir, Vice President, Bell & Zoller Coal and Mining Company, heads distinguished committee — National exposition an assured success with large group of manufacturers participating—Dates of May 13-17, inclusive,—selected

DEVELOPMENTS in coal-mining methods and discussions of practical mine-operating problems in the various coal-producing districts of the country will be considered at the Sixth Annual Convention of Practical Coal Operating Officials, to be held during the week of May 13, at Music Hall, Cincinnati, Ohio, under the auspices of the Manufactures Division of The American Mining Congress.

Mr. Paul Weir, Vice President, Bell & Zoller Coal and Mining Company, Chicago, heads a distinguished committee of 60 representatives of the various coal districts. H. A. Buzby, President, Keystone Lubricating Company, Philadelphia, Pa., Chairman of the Manufacturers Division of The American Mining Congress, is cooperating with the committee, and arranging for the National Exposition to be held in conjunction with the convention.

There will be eight major sessions of the convention, and an additional morning set aside entirely for the inspection of exhibits. In arranging the program the committee has departed from the style followed during the past five years, and will attempt at each session to discuss the entire cycle of production from face to railroad car. The sessions will also attempt to cover mining practice in each of the coal-producing districts, which will enable any delegate attending in a minimum of time to acquire a wide picture of the latest practices in coal production. It has been found that the average delegate stays at the meeting approximately two days. The program has therefore been arranged to permit him, within that time, to hear discussions on all phases of production covering four major producing districts. It also gives him more time for inspection of exhibits and does not require him to concentrate upon any one subject for either a whole session or an entire day.

The districts covered by the program include the anthracite field — Colorado, Wyoming, Montana and New Mexico; Illinois, Indiana and Western Kentucky; Southern West Virginia, Virginia, Eastern Kentucky, Tennessee and Alabama; Pennsylvania, Ohio, Northern West Virginia and Maryland; Missouri, Kansas, Oklahoma, Arkansas and Iowa.

An imposing program has been arranged, the details of which will appear in the April issue of this publication.

Out of a wealth of suggestions which were received in response to its request for topics for consideration at Cincinnati the program committee for the The American Mining Congress is drafting a program which promises to command the attention of the coal industry of the country. Representatives of a large number of companies from all of the coal-producing regions of the country met at Pittsburgh February 8 to draft the preliminary program.

In addition to Paul Weir, of Chicago, the chairman, the following members of the committee attended the meeting: Dr. L. E. Young, of Pittsburgh; W. L. Robison, of Cleveland; T. Y. Williams, consulting engineer of Pottsville, Pa.; T. R. Johns, general manager of coal mines of the Bethlehem Mines Company; T. F. McCarthy, of Indiana, Pa., assistant general superintendent of the Clearfield Bituminous Coal Corporation; J. William Wetter, of Madeira, Hill and Company; W. L. Affelder, of Pittsburgh, vice president of the Hillman Coal and Coke Company, and A. C. Callen, of the University of Illinois, of Urbana.

The meeting was also attended by the following members of the board of governors of the Manufacturers Division: J. C. Wilson, of the Ohio Brass Company of Mansfield; J. T. Ryan, of the Mine Safety Appliances Company of Pittsburgh; P. H. Grunnagle, of the Westinghouse Electric and Manufacturing Company of Pittsburgh; E. R. Phillips, of the Timken Roller Bearing Company of Canton, Ohio; Charles S. Hurter, of the Dupont Company of Wilmington; T. V. Stevenson, of the Morse Chain Company of Ithaca; and L. W. Shugg, of the General Electric Company of Schenectady, who will be director of exhibits at the Cincinnati Exposition through the courtesy of that company. The American Mining Congress was represented by G. B. Southward, its mechanization engineer; J. M. Hadley; and E. R. Coombes, who is secretary of the program committee.

The program committee for the Cincinnati meeting is made up of the following:

PROGRAM COMMITTEE

CHAIRMAN: Paul Weir, Vice Pres., Bell & Zoller Coal & Mng. Co., Zeigler, Ill.

Alabama: Frank G. Morris, Gen. Supt., Coal Mines, Southern District, Republic Iron and Steel Co.; G. L. Chamberlin, Gen. Mgr., Southern Coal and Coke Co.; Chas. F. DeBardeleben, Jr., Pres., Markeeta Coal Co.; Morris W. Bush, Pres., Alabama By-Products Co.

Arkansas: Heber Denman, Pres., Paris Purity Coal Co.; T. J. Thompson, Arkansas Mining Co.;

Colorado: G. P. Bartholomew, Gen. Mgr., Coal Mining Dept., American Smelting & Refining Co.; Robt. McAllister, Chf. Mine Inspector, Colorado Fuel & Iron Co.; F. W. Whiteside, Chf. Engr., Victor-American Fuel Co.; R. M. Perry, Gen. Supt., Moffat Coal Co.

Illinois: J. E. Jones, Mng. Engr., Old Ben Coal Corpn.; H. A. Treadwell, Chf. Engr., Chicago, Wilmington & Franklin Coal Co.; Paul Weir, Vice Pres., Bell & Zoller Coal & Mng. Co.; M. F. Peltier, Vice Pres., Peabody Coal Co.; F. S. Pfahler, Vice Pres. and Gen. Mgr., Superior Coal Co.; C. C. Wilcox, Vice Pres., St. Louis & O'Fallon Coal Co.

Indiana: David Ingle, Pres. and Treas., Ayrshire Coal Co.; Chas. Gottschalk, Vice Pres. and Gen. Mgr., Big Vein Coal Co.; J. R. Henderson, Gen. Mgr., Francisco Coal Co.

Kansas-Missouri-Oklahoma: J. G. Puterbaugh, Pres., McAlester Fuel Co.

Kentucky: L. C. Skeen, Mgr. of Coal Mines, Fordson Coal Co.; R. E. Galbreath, Chf. Engr., Wisconsin Steel Co.; T. E. Jenkins, Vice Pres., West Kentucky Coal Co.

Maryland: W. C. Snyder, Gen. Mgr., Consolidation Coal Co.; Dr. J. J. Rutledge, Chf. Mine Engr., Md. Bureau of Mines.

New Mexico: Frank Young, Mng. Engr,. St. Louis, Rocky Mtn. and Pacific Co.; H. D. Moses, Mgr., Gallup-American Coal Co.; W. D. Brennan, Gen. Mgr., Phelps Dodge Corpn; Oscar Huber, Gen. Supt., Albuquerque & Cerrillos Coal Co.

Ohio: R. L. Ireland, Gen. Mgr., M. A. Hanna Coal Mines; W. L. Robison, Vice Pres., Youghiogheny and Ohio Coal Co.; Ezra Van Horn, Gen. Mgr., Clarkson Coal Mng. Co.

Pennsylvania (Anthracite): J. B. Warriner, Vice Pres. and Gen. Mgr., Lehigh Coal and Navigation Co.; Cadwallader Evans, Gen. Mgr., Hudson Coal Co.; R. Y. Williams, Cons. Engr., Pottsville; B. H. Stockett, Gen. Mgr., Weston, Dodson & Co.

Pennsylvania (Bituminous): T. R. Johns, Gen. Mgr., of Coal Mines, Bethlehem Mines Co.; T. F. McCarthy, Asst. Gen. Supt., Clearfield Bituminous Coal Co.; S. W. Blakslee, Mine Supt., Pennsylvania Coal and Coke Co.; E. J. Newbaker, Gen. Mgr., Berwind-White Coal Mng. Co.; Dr. L. E. Young, Vice Pres., Pittsburgh Coal Co.; Percy C. Madeira, Pres., Madeira, Hill and Co.; W. L. Affelder, Vice Pres., Hillman Coal & Coke Co.

Tennessee: Hugh P. Finley, Supt., Proctor Coal Co.; C. E. Abbott, Mgr., Mines & Quarries, Tennessee Coal, Iron and Railroad Co.

Utah: Otto Herres, Asst. Mgr., United States Fuel Co; I. N. Bayless, Gen. Supt., Utah Fuel Co.

Virginia: G. T. Stevens, Chf. Engr., Clinchfield Coal Corpn.

West Virginia: Thos. G. Fear, Gen. Mgr. of Operations, Consolidation Coal Co.; J. D. Francis, Vice Pres., Island Creek Coal Co.; Edward Graff, Mng. Engr., The New River Co.; H. B. Husband, Gen. Mgr. of Coal Mining, Chesapeake and Ohio Rwy. Co.; Thos. Clagett, Chf. Engr., Pocahontas Coal and Coke Co.; C. L. Chapman, Asst. to Pres., West Virginia Coal and Coke Co.

Washington: Geo. Watkin Evans, Cons. Engr., Pacific Coast Coal Co.

Wyoming: F. V. Hicks, Mech. Engr., Union Pacific Coal Co.; Edw. Bottomley, Gen. Supt., Sheridan-Wyoming Fuel Co.; Gomer Reese, Gen. Supt., Kemmerer Coal Co.

The exposition space in both North and South wings of the Music Hall in Cincinnati is practically all reserved. The following is a list of the exhibitors to date; where an exhibitor has taken more than one space the number is given in parentheses:

Ahlberg Bearing Co., Chicago, (2); American Car and Foundry Co., New York, (4); Atlas Powder Co., Wilmington, Del.; American Cable Co; Automatic Reclosing Circuit Breaker Co, New York; Allen & Garcia Co., Chicago, Ill.; American Mine Door Co., Canton, Ohio; American Steel and Wire Co.

Bonney Floyd Co., Columbus, Ohio, (2); Brown Fayro Co., Johnston, Pa., (2); Bethlehem Steel Co., Bethlehem, Pa., (9); Baldwin Locomotive Co.

Carnegie Steel Co., Pittsburgh, Pa., (10); Chicago Pneumatic Tool Co., New York City, (2); Conveyor Sales Co.

Deming Company, Salem, Ohio; E. I. du Pont de Nemours & Co., Wilmington, (2); Deister Concentrator Co., Ft. Wayne, Ind.; DeWalt Products Corp., Leola, Pa.; Diamond Machine Co., Monongahela, Pa.

Eagle Iron Works, Des Moines, Iowa; Edison Storage Battery Co., Orange, N. J., (2); Electric Railway Equipment Co., Cincinnati, Ohio; Electric Railway Improvement Co., Cleveland, Ohio; Enterprise Wheel & Car Corp., Bristol, Tenn.-Va., (2); Electric Storage Battery Co., Philadelphia, Pa., (2).

Fairbanks, Morse & Co., Chicago, Ill., (3).

General Electric Co., Schenectady, N. Y., (8); Goodman Mfg. Co., Chicago, Ill., (4).

Hazard Wire Rope Co., Wilkes-Barre, Pa.; Hendrick Mfg. Co., Carbondale, Pa.; Hercules Powder Co., Wilmington, Del.; Hockensmith Wheel & Car Co., Penn, Pa.; Holstein, P. W., Columbus, Ohio.; Hyatt Roller Bearing Co., Harrison, N. J.

H. A. Buzby, Chairman of the Manufacturers' Division of The American Mining Congress

Paul Weir, Chairman of the Program Committee for the Cincinnati meeting

Ideal Commutator Dresser Co., Sycamore, Ill.

Jeffrey Mfg. Co., Columbus, Ohio, (3); Joy Mfg. Co., Franklin, Pa., (3).

Keystone Lubricating Co., Philadelphia, Pa., (2); Koppers-Rheolaveur Corp., Wilkes-Barre, Pa., (2).

LaBour Co., The, Chicago Heights, Ill.; Lincoln Steel & Forge Co., St. Louis, Mo.; Link-Belt Co., Chicago, Ill.; Leschen & Sons Rope Co., A.; Lorain Steel Co.

McGraw Hill Catalog & Dir. Co., (2); Mancha Storage Battery Loco. Co., St. Louis, Mo., (3); Mining Congress Journal; Mining Safety Device Co., Bowerston, Ohio; Mine Safety Appliances Co., Pittsburgh, Pa., (2); Morrow Mfg. Co., Wellston, Ohio, (2); Modern Mng. Pub. Co., Pittsburgh, Pa.; Morse Chain Co., Ithaca, N. Y.; Myers-Whaley Co., Knoxville, Tenn., (3); Martin Co., H. D., Cincinnati, Ohio.

National Carbon Co., Cleveland, Ohio, (2); National Malleable & Steel Castings Co., Cleveland; Niagara Concrete Mixer Co., (2); Norma-Hoffman Bearings Corp., Stamford, Conn., (2); Nuttall Co., R. D.

Ohio Brass Co., Mansfield, Ohio, (4); Osborne Register Co., Cincinnati, Ohio.

Pennsylvania Mng. Machinery Corp., St. Benedict, Pa., (2); Phillips Mine & Mill Supply Co., Pittsburgh, Pa.; Post Glover Electric Co., Cincinnati, Ohio; Pittsburgh Knife & Forge Co., Pittsburgh, Pa.; Portable Lamp & Equipment Co., Pittsburgh, Pa.; Pennsylvania Crusher Co., Philadelphia, Pa., (2); Pittsburgh Coal Washer Co., Ambridge, Pa., (2); Pure Oil Co., Columbus, Ohio.

Roberts and Schaefer Co., Chicago, Ill., (2); Roebling's Sons Co., John A., Trenton, N. J.; Robinson Ventilating Co., Zelienople, Pa.; Rome Wire Co., Rome, N. Y., (2).

Safety Mining Co., Chicago, Ill., (2); Sanford-Day Iron Works, Inc., Knoxville, Tenn., (4); S. and S. Mfg. Co., Centralia, Ill.; Simplex Wire and Cable Co., Chicago, Ill.; Streeter-Amet Weighing & Rec. Co., St. Louis, Mo.; Sullivan Machinery Co., Chicago, Ill. (10); Schonthal, B. E., Chicago, Ill.

Templeton, Kenly & Co., Ltd., Chicago, Ill.; Traylor Vibrator Co., Denver, Colo., (2); Timken Roller Bearing Company, Canton, Ohio, (2); Tracy Co., Bertrand P., Pittsburgh, Pa., (2); Tyler Co., W. S., Cleveland, Ohio, (2); Tool Steel Gear and Pinion Co., Cincinnati, Ohio.

United Wood Treating Corp., Chicago, Ill.; U. S. Bureau of Mines.

Watt Car and Wheel Co., Barnesville, Ohio, (2); Waverly Oil Works Co., Pittsburgh, Pa.; Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa., (8); West Virginia Rail Co., Huntington, W. Va., (2); Weinman Pump Co., Columbus, Ohio; Whetstone, T. F., Cincinnati, Ohio.

Jessup Breaker Burns With Loss of $150,000

The Sunnyside breaker, of Humbert Coal Company at Jessup, Pa., was totally destroyed by fire the night of February 5, entailing a loss estimated roughly at $150,000. Origin of the fire is undetermined.

Martin J. Loftus, president of Humbert Coal Company, announced later that plans are already under way for the rebuilding of the structure.

More than 300 men will be thrown out of work because of the fire.

Railway Association Asks Cooperation of Coal Association Regarding "No Bill Coal"

At the suggestion of the Committee on Car Service of the American Railway Association, Executive Secretary Gandy and Traffic Manager Battle, of the National Coal Association, early in February conferred with M. J. Gormley, chairman, and W. J. McGarry, manager of the Car Service Division of the former association, relative to no bill coal on mine tracks. Messrs. Gandy and Battle were informed that the Committee on Car Service, composed of transportation officers of 14 railroads, had under consideration the question of no bill coal loads on mine tracks and mine sidings for excessive periods, free of demurrage, and recommended that the Car Service Division conduct a survey to determine the number of such no bill loads on hand as of a given date.

Messrs. Gormley and McGarry advised that the figures accumulated by the Car Service Division as the result of a survey indicated that as of June 1, last, there were no bill loads on hand as follows:

Number of cars held 10 days or less	15,402
Number of cars held 20 days and over 10 days	3,210
Number of cars held 30 days and over 20 days	1,577
Number of cars held more than 30 days	2,858
Total	23,047

Gandy and Battle were informed that the Committee on Car Service further directed that the information obtained as the result of that survey should be used in securing action by operators, through the National Coal Association, which, if possible, would tend to provide a remedy against the excessive delays which are occurring. Mr. McGarry further said: "The underlying thought of the Committee on Car Service in submitting this recommendation for cooperative consideration is that unless the coal industry and the railroads can, through cooperative action, work out a solution tending to eliminate the abuses which have crept in under the distribution rules now in effect the railroads will be under the necessity, by order of the commission, of applying demurrage at mines and mine sidings."

DRAINAGE AND PUMPING
(*From page 230*)

the small motors. As to the use of 2,200 volts in underground work, we have had no more difficulty than in handling 110 volts, provided the proper safeguards are used and the pump operators properly instructed in their use.

Once a year each pump is disassembled and thoroughly overhauled, new sleeves put on the shafts, and, except for an occasional packing, are good for another year of continuous operation.

As was previously mentioned, steel doors were installed to control the flow of water. These were set as soon as the headings were driven far enough from the station to permit the construction, which consisted of a heavy casing or door frame, built of concrete and fitted with steel doors fabricated in our own shops. These have proven their worth many times, particularly during the summer months when severe electric storms are of frequent occurrence. In case of an interruption of power or in case there is a temporary flow of water beyond the capacity of the pumps (which happened frequently during the first year of operations on the twentieth level) the doors are closed and the flow of water is regulated to the pump capacity through a control valve. This valve operates for a period of hours, or even days, until the water has subsided sufficiently for the doors to be opened and work resumed in the headings.

One pumpman on each shift takes care of the pumps, except for the time between shifts, Sundays and holidays, when as a matter of policy, two men are on at the same time.

Pumping Data, Based on Month of January, 1927

Number of pumps	9
Total capacity (gallons per minute)	5,200
Number of motors	9
Total horsepower of motors	845
Load factor (percent)	91¾
Gallons per minute (average for month)	4,771
Total K. W. hours	433,500
Cost per K. W. hour	$0.0108
Cost per 1,000 gallons pumped	$0.022
Combined efficiency of pumps and motors (percent)	59
Vertical lift (feet)	381

90° V Notch weir used for measuring flow.

WITH THE MANUFACTURERS

Hercules Perfects New Type Blasting Machine

Representing a new departure in American electrical machine design, a new pocket size blasting machine is announced by engineers of the Hercules Powder Company, Wilmington, Del.

It is the first machine of American design to apply the dynamo principle to a blasting machine of such compactness. It weighs only $4\frac{3}{4}$ pounds and will slip into an ordinary coat pocket. The dynamo principle assures its permanent capacity in contrast to the old magneto type which lost power with age. It is rated to fire 10 electric blasting caps connected in series, but all tests have shown a 100 percent power reserve.

The new machine is the development of three years' work and experiment. It is called the Hercules 10-cap blasting machine, and is an extremely convenient size for any kind of blasting where not more than 10 shots are fired at once. Any reader can secure a circular description of the new machine by addressing the Hercules Powder Company and mentioning THE MINING CONGRESS JOURNAL.

Prest-O-Lite Takes Over Acetyle Products Company

On January 1, 1929, The Prest-O-Lite Company, Inc., acquired the business of the Acetylene Products Company, which operated two acetylene producing plants located, respectively, at 401 East Buchanan Street, Phoenix, Ariz., and at 914 Texas Street, El Paso, Tex.

These plants are now being operated as units of the Prest-O-Lite chain. Including these additions, the Prest-O-Lite plants now number 38, located at industrial centers throughout the country to supply the local demand for dissolved acetylene used in welding and cutting.

Everett R. Kirkland is superintendent of the Phoenix plant, and Carl F. Chesak is superintendent of the El Paso plant. R. G. Daggett, whose headquarters are at the San Francisco office, is district superintendent.

Calumet & Arizona Places Order for Large Electric Hoist

Calumet & Arizona Mining Company have just placed contract with the Allis-Chalmers Mfg. Company for a large double drum electric hoist. This unit will have 10-ft. diameter drums to wind 3,800 ft. of $1\frac{3}{8}$-in. rope in two layers. It is designed for a maximum rope pull of 31,300 lbs. to operate at a speed of 2,000 ft. per minute. Both drums will be clutched, the brakes and clutches operated by oil-operated auxiliary engines. The unit will be driven by a 1,350 hp., 550 volt, 400 r. p. m. direct-current motor connected to the hoist through a single reduction of Falk gears. This motor will be supplied with motor generator flywheel set, consisting of a 1,000 hp. induction motor coupled to a 1,250 kw. generator, and will have a plate wheel mounted at the end of the set, which wheel will weigh, with shaft and coupling, 62,000 lbs. The wheel will be coupled to the set, so that for a year or so the wheel can be left disconnected on account of the lighter loads which will be handled at that period.

This hoist, which is for their Campbell shaft, Warren, Ariz., will be one of the largest in the Southwest and will incorporate the latest control devices and safety features so far developed in the art for a hoist of this type.

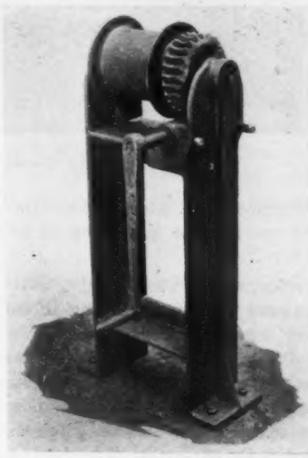
N. E. L. A. Meeting

The spring meeting of the National Electrical Manufacturers Association will be held at The Homestead, Hot Springs, Va., May 20-25, 1929.

Floor Type Hand Operated Winch

The Stephens-Adamson Mfg. Co., of Aurora, Ill., announce the addition of a floor type, hand-operated winch to their line of motor and hand winches. This winch is mounted on a cast iron stand which is sturdy though light in weight. It has a cast iron worm gear which is self-locking, thus insuring the safety of the load at all times.

The winch has a rope pull of 750 lbs. at the drum. The cast iron drum, which is 6 in. in diameter, has a capacity of 100 ft. of $\frac{1}{4}$-in. cable and 60 ft. of $\frac{3}{8}$-in. cable. From the top of the drum to the floor is 34 in., while the over-all width is 18 in. This hoist is attached to the floor by means of 4 bolts in the cast iron



stand base. As the winch is light and portable, it can be used in any part of the plant, thus assuring its value to any company. Alemite high pressure fittings are used to lubricate the winch.

Under Voltage Devices Operate After Time Interval

To meet the demand for a device to protect against failure of voltage in power circuits after a suitable interval has elapsed, the General Electric Company has introduced two new equipments bearing the designations MG-2 and PF-2. These are especially designed to trip the breaker in the circuit only after a suitable time interval, and will not cause interruptions to service when momentary voltage dips occur.

MECHANIZATION OF TIMBERING FOR ROOF SUPPORT

ONE of the hardest jobs still largely done by hand in a coal mine, according to the Goodman Manufacturing Company, is the cutting of "hitches" in the ribs for receiving and carrying the ends of cross bar timbers for supporting a weak top. The work is laborious, being done close to the roof. And when the cutting is hard, either in coal or in slaty rock, it becomes still more difficult, if not impossible. Also, there is the danger of eye injuries in cutting at or near head level.

Operators who keep careful costs are well aware that hand cutting of hitches is very expensive; done usually on day work basis, the real costs often are not accurately known by those who give the matter only casual attention.

The square set avoids the hitch cutting costs, but its saving is offset by the cost of the leg timbers and such framing as may be necessary. It also cuts down the width of the entry, unless added expense be incurred in cutting rib slots to receive the legs, partly or wholly. The square set also introduces liability of roof caving, at just the worst possible time, if the legs be knocked aside by a wrecked trip or a derailed locomotive.

For these and other reasons the hitch-supported cross bar is generally preferable, even at higher cost. It is more nearly permanent, and generally safer. If, then, the cost of the hitches can be materially reduced the advantages of the cross bar method may be enjoyed on an economical basis.

Reduction of cost is effected—and other advantages introduced—by cutting round hitch holes with a new machine built by the Goodman Manufacturing Company—the "Strongarm Driller." This drill cuts a hole 9 in. or more in diameter. The 9-in. hole contemplates the use of steel beams or rails for the cross bars; larger holes may be required for cross bars of wood.

The machine does in minutes the equivalent of hours of hand work. It gives a firmer support—horizontal as well as vertical—for the cross bar, and thereby a more nearly permanent job. It makes comparatively easy work of harder cutting than is practicable by hand pick. It cuts close to the roof and thereby reduces the use of lagging to a minimum. In short, it mechanizes the timbering, with all the advantages sought in mechanization of any mine operation—speed, safety, economy, general utility.

Figure 1. The Goodman Strongarm Drilling Machine

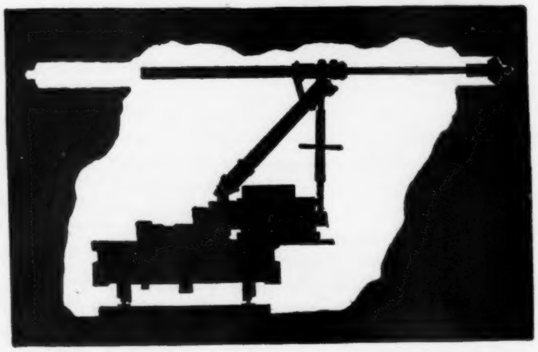
Figure 1 (above) shows the machine in operation. It drills opposite holes in the two ribs, one hole deeper than the other to facilitate placing of the cross bar by first inserting one end into the deeper hole, to give the other end clearance for entering the opposite hole. Carried properly equally by each rib, the bar is wedged into place, and may be still more firmly set by grouting with concrete. This makes a finished job of absolute permanence in every underground sense.

The operating assembly of the machine is carried on a turntable, mounted to slide on crosswise of the track. The turntable provides for training the cutter head to either right or left, and then the operating assembly may be slid forward or backward to suit far or near cutting. Figure 2 (below) shows the drilling of a hitch hole to the right, with the mechanism slid to the right to reach a distant rib. This illustration shows the flexibility of the machine in a horizontal plane, at any height within the range of the construction.

For vertical adjustment the diagonal shaft-arm, pivoted at its lower end, is set at any desired height by quick-action hand turnbuckle arrangement, actuating the upper end of the diagonal arm. With the supporting members thus set for proper height, the pivoted drill member is readily set for either horizontal or inclined drilling. The provision for inclined setting enables drilling level when on tilted track or for drilling parallel to a sloping roof.

All operations, including travel of the machine, are actuated by one large motor. All parts are rugged and heavy, yet the whole construction is extremely simple. Alloy steels, properly heat treated, are used for all parts wherein they are of advantage. Accessibility is a definite feature, and any unit in the assembly can be inspected easily, or can be removed by loosening not more than four screws. Lubrication is easy, ample and simple; most of the gearing runs in oil-tight cases.

Figure 2. Drilling a hitch-hole



The machine is operated in all its functions—and cared for in all its parts—by just one man, who need be of no more than ordinary intelligence, with reasonable common sense. It is self-propelling, and may be had with or without an electric cable reel.

Detailed information may be had by inquiry of the builder, the Goodman Manufacturing Company, Chicago, Ill.

Du Pont Explosive Department Holds Meeting

Nearly 100 representatives attended the twelfth annual convention of the Technical Section of the Explosives Department of E. I. du Pont de Nemours & Company at Wilmington, Del., February 5, 6 and 7. Besides the explosives technical force of the field and the main office, there were present company executives, officials of the explosives department, heads of the chemical staff, plant managers, and representatives of the sales and the advertising departments.

Arthur La Motte, manager of the Technical Section, presided. "The Activities of the Year" formed the keynote on which numerous papers were based.

J. Thompson Brown, general manager of the Explosives Department, addressed the convention at the opening session. Mr. Brown outlined the work of last year and described the interrelationships of the various departments of the du Pont Company and the subsidiary concerns.

Pellet powder, which was introduced in the American mining industry by du Pont, was a principal topic of discussion. In this connection, the fact developed that a high percentage of the du Pont black powder mill production is now pellet powder, while 40 percent of the total sales of black powder is for use in coal mines.

Safety in the underground handling of explosives and cooperation among mine officials and company technical men with a view to the more efficient uses of permissibles and other types of powder were given lengthy consideration.

Practically every phase of the uses of explosives for industrial purposes was covered in discussions which included tunneling, quarrying, coal and ore mining, and other work requiring dynamite, permissible high explosives, black powder, pellet powder and other types. Blasting caps, fuse, blasting machines, and other accessories were subjects of papers and discussions.

L. P. Mahony, director of sales of the Explosives Department, discussed trade practices and various angles of the activities of the technical staff in connection with sales work.

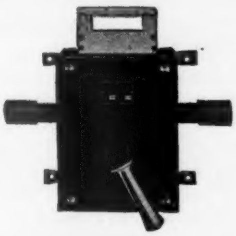
New Radial Switches Have Renewable Segments

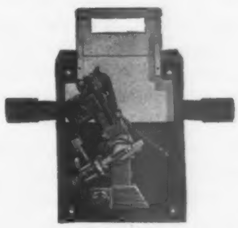
A complete new line of radial rheostat switches, for varying the fields of large electric machines such as generators, motors, etc., is announced by the General Electric Company. The switches are for general application where the current is more than 50 amperes and not over 300 amperes. There are five forms, for hand, sprocket, gear, solenoid and motor operation.

Prominent Car Builder to Market Pit-Car Loader

The Mt. Vernon Car Mfg. Co., of Mt. Vernon, Ill., manufacturers of all kinds of mine cars, as well as car wheels, castings, forgings and railroad freight cars, are preparing to serve the mining industry in another way with the manufacture

of a pit-car loader, shown in the accompanying illustration. This loader will be strictly a two-man machine; in fact, the builders claim that one man can handle it about as easy as two men could a 4-ton pit car. This is accomplished through the introduction of an extra pair of wheels near the floor end of the conveyor. These have a vertical adjustment, so that the end of the conveyor rests on the floor when at the loading face.





Circuit Breaker Sectionalizes Mine Trolley and Power Circuits

A 1,200-ampere automatic circuit breaker and single pole knife switch enclosed in an insulated case has just been put on the market by the Ohio Brass Company, Mansfield, Ohio. It is a protective device for sectionalizing mine trolley and power circuits at butt headings, for the entrance of each of a group of small mines working from one power house, or for an electric distribution line arrangement where a branch circuit handles current for a number of machines or locomotives. So placed, the circuit breaker will localize power interruptions from short circuit and unreasonable overload without affecting the whole system.

While the continuous rating of this breaker is 1,200 amperes, it can be adjusted to take care of momentary peak loads of 1,500 amperes. The current is automatically interrupted on the circuit breaker contacts when it exceeds the value at which the setting is made on the trip armature and it is impossible to close the breaker against short circuit or overload. Being manually operated it stays out until the trouble has been eliminated which affords protection against fire due to a grounded trolley or feeder wire.

Circuit breaker and hand operated knife switch are absolutely interlocked, compelling proper sequence of operation. Opening of the breaker always takes place at the arcing tips attached to the block contacts, thus eliminating the possibility of burning these surfaces. Arcing tips, arc shute, blow-out coil and vent positively extinguish the arc without destructive burning.

Roberts and Schaefer Gets Contracts

Recent contracts for coal preparation plants placed with Roberts and Schaefer Company, engineers and contractors, of Chicago, include the following:

Wacomah Coal Company, Amigo, W. Va., Menzies hydro-separator coal washery equipment, capacity 50 tons per hour, work to be completed March 1.

Sharon Coal and Coke Company, Sharondale, Ky., four-track Marcus coal tipple of steel construction, capacity 250 tons of run of mine coal per hour, work to be completed June 1.

Empire Coal and Coke Company, Landgraff, W. Va., coal sizing and cleaning equipment for preparing pea, stove and egg sizes, embodying Menzies hydro-separator for washing, capacity 50 tons per hour, work to be completed by May 1.

Detroit Mining Company, Gordon, W. Va., coal-washing equipment embodying the use of Menzies hydro-separators and Arms screens, capacity 100 tons per hour, work to be completed April 1.

Valley Mining, Inc., Nelsonville, Ohio, coal-washing equipment embodying the use of Menzies hydro-separator and Arms screen, capacity 50 tons per hour, work to be completed April 1.

UTAH COPPER NOW WORLD'S LARGEST ELECTRIFIED METAL MINE

THE Bingham, Utah, mining properties of the Utah Copper Company can now claim the distinction of being the world's largest electrified metal mine. The electrification of the haulage system of this mine, starting on a large scale early in 1928, has now progressed to a point where the electric equipment involved is the most complete and up-to-date of any metal mining project.

Although the actual mining operations had already been electrified, using electric shovels, the haulage system had, up to the middle of 1928, been of the steam type. A trial locomotive was built by the General Electric Company and was found satisfactory in service. Plans were then made for the installation of 20 General Electric locomotives, with suitable substation equipment, and more than half of these are now in service. In addition to those of the original 20 still to be put in service, an additional 20, also to be built by the General Electric Company, will be used as soon as they can be built and delivered, and it is expected that possibly a few in addition to this number will be required to complete the haulage program. Thus this mine will have in use by far the largest number of electric locomotives ever applied to an open-cut mining operation.

The copper ore is found on both sides of the canyon in which the town of Bingham is situated. Giant electric shovels working on successive terraces cut in the mountain face, remove the overburden which covers the ore, and then the ore itself. The overburden is deposited in cars which are hauled away by the electric locomotives and dumped down another side of the mountain, while the ore itself, also in cars, is hauled to the mills at Magna, 17 miles distant.

All the locomotives are specially designed for this service. Seven of the entire 41 involved are a combination type particularly valuable for operation where power can not always be obtained from the usual overhead system. Each unit has facilities for overhead collection of current, side-arm collection or for operation by means of storage batteries. In addition, the 41 locomotives are each equipped with a cable reel collector by means of which power can be delivered to the locomotive over a considerable distance from the supply point by means of a trailing cable.

The locomotives are of very heavy construction, each being rated 75 tons.

Power for this haulage system will be supplied from a number of substations, two of which are already in use, and an extensive electrification system is necessary for distributing the power to the points where it is needed. The electric locomotives haul the ore cars up the side of the mountain by means of switchbacks, over the various benches, and to the shovels. There the cars are loaded and hauled back down to the foot of the mountain, where they are made up into long trains and transported to the mill over the Bingham & Garfield Railroad.

The locomotives are described by the General Electric Company as being of the articulated truck, steeple cab type, with rigid frame, made up of heavy steel plate sides carried on combination semi-elliptic and helical springs. The main cab of the storage battery type units is over 10 ft. square, and in this cab is the engineer's seat and control stations with other necessary electric equipment.

Four large totally-enclosed motors drive each locomotive. These motors are controlled by a single-unit, three-speed control system arranged for series, series parallel and parallel operation, with resistors of sufficient capacity for the service cut in and out by solenoid-operated contactors. Complete protection and metering equipment is provided by suitable relays and instruments.

The overhead pantagraph trolley is raised by a spring and lowered by air pressure. Both operations are controlled by the engineer in the cab. In addition, there are two side-arm pantagraph trollies, one mounted on each side of the cab room. These are extended and withdrawn by air, also under control of the engineer.

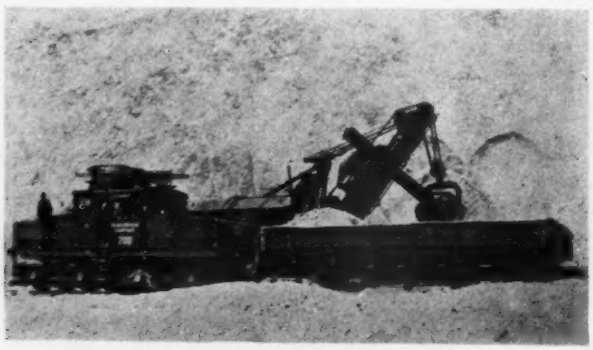
The electric cable reel, mounted under the platform beneath the cab, carries a suitable length of flexible rubber-covered cable, and is of the vertical axis type driven by a motor which automatically winds and unwinds the required length of cable as the locomotive moves toward or away from the source of power.

In the storage battery locomotives a ball bearing, battery-charging, motor-generator set in the cab is arranged to charge the battery through its control without the use of a charging resistor. A two-stage air compressor, also in the cab, provides the necessary air for operating the air brake equipment.

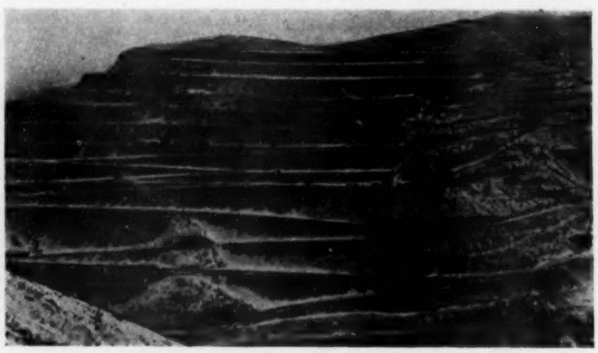
Warrior River Towboat Ready for Service

The Diesel-electric towboat which has been under construction for the Tennessee Coal, Iron & Railroad Company was given her trials recently and left January 22 for the Warrior River in Alabama where she will be put in service. The boat was built by the American Bridge Company at Clarion, Pa., and was outfitted by the Carnegie Steel Company of Pittsburgh.

The boat is electrically equipped excepting only the cooking and heating, steam for the latter being provided by a small donkey boiler. The power plant consists of two 550-horsepower Diesel engines manufactured by the New London Ship & Engine Company, each direct connected to a 335-kilowatt, 250-volt, 250-r.p.m., direct-current generator. Each propeller is driven by a shunt-wound, double motor rated 400 horsepower, 140 r.p.m., 250 volts. All the electric equipment was furnished by the General Electric Company.



Electric shovel and electric locomotive



General view of the shovel workings

Link-Belt Announces a Complete Line of Gasoline Locomotive Cranes

Link-Belt Company, Chicago, Ill., has announced a complete line of locomotive cranes designed especially for gasoline engine, Diesel engine or electric motor drive, to be known as the "L" type cranes.

They are designed throughout for the severe conditions imposed by a power unit running continuously at its full operating speed.

The machinery and its arrangement are particularly adapted to direct engine or motor drive, and all clutches, brakes, shafts, bearings, gears, etc., are oversize.

The L-50 Crane

The drive from engine or motor is a totally inclosed silent chain drive, and all upper frame gears have machine-cut teeth, cut from solid blanks. It is furnished with two-speed travel gear to give a high travel speed for traveling light, and a slower travel speed for pulling heavy loads or ascending comparatively steep grades. The two-speed travel gear in nowise affects the other speeds of the machine (hoisting, boom hoisting and rotating).

The addition of the "L" type crane in five sizes gives Link-Belt Company a complete line of gasoline, Diesel, electric and steam locomotive cranes, and a line of heavy duty gasoline, Diesel, or electric crawler shovels, cranes, draglines ranging from ¾ cu. yd. to 2 cu. yd. capacity.

New Cam Tips Take 6-0 Wire

To meet the demand for 6-0 trolley wire fittings the Ohio Brass Company, Mansfield, Ohio, announces that they are now making 2½-in. renewable bronze cam tips for 6-0 round and grooved wire. These cam tips afford an easily renewable approach for malleable iron frogs, cross-overs, etc.

Joy Machines Load Large Tonnage

During the past year, approximately 47 percent more tonnage was loaded by Joys than in 1927, according to the Joy Manufacturing Company, Franklin, Pa. Incomplete returns indicate a total of 15,000,000 tons for 1928; though three less new machines were installed in 1928 than in 1927. These figures clearly indicate the increasing tonnage being produced per machine employed.

Of the total number of new machines installed, 49.2 percent were repeat orders, and 50.8 percent new business. These figures do not include the number of old machines sent in to the factory for installation of recent improvements. The repeat order business came from Utah, Wyoming, Montana, Illinois, Indiana, Pennsylvania, and West Virginia; while the new installations were made in Wyoming and Illinois.

New Across-the-Line Switch is Oil-Immersed

A new General Electric control device is the CR-2960-SY-105, a small, inexpensive, oil-immersed switch for use in throwing small alternating or direct-current motors across the line. It is a very simple device having a minimum of component parts; a one-piece, cast-iron cover, including the switch mechanism, and a small, cast-iron tank for the oil.

The molded compound switch base carries the stationary contact stud parts, and the moving contact assembly is mounted on another one-piece molded part. The contacts are of the silver-to-silver, double-break type. The use of these contacts and of the molded arm eliminates shunts or drum-type contacts.

The cover is provided with two mounting holes, making the switch suitable for wall mounting. Provision is made for conduit connection by means of an incoming conduit box cast into the cover. The molded switch base is bolted to the cover. The cover has a groove, lined with felt, into which the top of the tank fits, thus providing a tight installation. The tank is held in place by bolts with wing nuts. The handle is of malleable iron.

Portable Gasoline-Driven Compressors

Chicago pneumatic portable compressors, gasoline-engine driven, are now made in five sizes, viz: 100, 160, 220, 265 and 310 cu. ft. free air per minute. The complete line is described in detail in Bulletin 797, fourth edition, which has just been issued. A copy will be sent to anyone addressing the Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York City.

A New Indicator for Combustible Gases

The Union Carbide Sales Company, 30 East Forty-second Street, New York City, will presently place on the market a portable instrument that detects immediately the presence of a wide range of combustible gases or vapors and indicates whether or not the atmosphere containing these gases is safe to breathe and safe for flames or fire. This device was first developed by the engineers of the Union Carbide and Carbon Research Laboratories, Inc., as a methane indicating detector for the detection of methane or firedamp in coal mines. The methane indicating detector has successfully passed the rigid tests of the United States Bureau of Mines, and has received its approval as permissible equipment for use in methane and air mixtures. The U. C. C. gas indicator is identical in construction except for certain modifications to make the instrument better adapted to the detection of numerous combustible gases.

The indicator utilizes the effect of combustion of flammable gas and air mixtures on the surface of a heated filament. This combustion increases the temperature, and consequently the electrical resistance of the filament. This change in resistance causes the needle of a meter to move over a scale, from which the desired information relative to gas conditions is obtained.

The gas indicator comprises a detector head or combustion chamber, meter case, and portable storage battery.

The detector head consists of a cylindrical metal case or bonnet which screws onto a metal base equipped with a short carrying handle. A flexible twin conductor cable about 50 ft. long connects the detector head with the meter case. The meter case contains the various resistances in the detector circuit, the indicating meter, the control switch and a rheostat. A short flexible cable connects the meter case to the portable storage battery which supplies the power to operate the indicator.

The apparatus will be distributed by the Safety Appliance Department of the Union Carbide Sales Company and by Bullard-Davis, Inc.

Morse Stock Drives

The Morse Chain Co. has just brought out a new publication, Bulletin No. 35, devoted to stock sprockets and chain which are being carried in various localities. The data is arranged in an ingenious way, allowing the customer to select two or three different designs to meet his specifications, one of which may be most suited to his requirements. It is due to the increased demand for service that these drives from 1 to 25 hp. are being added and can be shipped within 48 hours, bored and keyseated to fit customers' shafts.

Morse Silent Chain Drives are carried in stock by the following:

Carolina Supply Co., Greenville, S. C.; Crago Gear Co., Kansas City, Mo.; Dodge-Newark Supply Co., Newark, N. J.; James Supply Co., Chattanooga, Tenn.; Moore-Handley Hardware Co., Birmingham, Ala.; Morse Chain Co., Detroit, Mich.; Morse Chain Co., Ithaca, N. Y.; Tranter Mfg. Co., Pittsburgh, Pa.

Mine Safety Appliances Company Opens Pacific Coast Branch

The Mine Safety Appliances Company, Pittsburgh, Pa., announces the opening of a Pacific coast branch, including offices and warehouse, at 318 East Third Street, Los Angeles, Calif. The Pacific coast branch is in charge of H. E. Munn, who received his early safety training with the United States Bureau of Mines and later was associated with the Jacklin metal mining interests. Mr. Munn is assisted by C. E. Gault, also formerly associated with the United States Bureau of Mines. The Pacific coast branch carries a substantial stock of M-S-A safety appliances, including Burrell all service gas masks, hose masks, McCaa oxygen breathing apparatus, H-H inhalators, Edison electric safety cap lamps, etc., and is especially well equipped for emergency services.

In addition to the Pacific coast branch, the western organization of M-S-A also includes the following district representatives: J. C. Calnon, El Paso, Tex.; T. R. Jones, Denver, Colo.; V. O. Murray, Salt Lake City, Utah; and H. H. Sanderson, Seattle, Wash.

Ohio Brass Catalog

The second Supplement to Catalog No. 20 which supersedes and replaces Catalog Supplement No. 1 has just been published by the Ohio Brass Company, Mansfield, Ohio. This new 64-page booklet of interest to electric railway and mine engineers and operators, contains complete illustrated descriptions of and ordering information for 60 new O-B devices developed since Catalog No. 20 was issued.

Fan-Cooled, Totally Enclosed Motors

Leaflet L-20384, describing a new fan-cooled, totally enclosed squirrel cage induction motor, has recently been published by the Westinghouse Electric and Manufacturing Company.

This motor is designed for use in locations where the service conditions are too severe to permit the use of a standard open motor. Foundries, cement mills, coke plants, and machine shops, are industries where this type of motor finds frequent application.

An important feature of this line of motors is that their size is approximately the same as that of a standard open motor of equivalent rating.

R. E. Gallaher Dies

Raphael Eccleton Gallaher, president of the New York Insulated Wire Company, died at his residence at 375 Park Avenue, New York, on February 10.

Mr. Gallaher, who was 78, was a pioneer in the wire and cable industry. In 1884 he organized the New York Insulated Wire Company, which is now a member of the Wire and Cable Section of the National Electrical Manufacturers Association. He held the position of secretary of his company from the time it was organized until 1927, when he became president.

Death of Matthew Griswold

Matthew Griswold, who retired as manager of the Erie (Pa.) Works of the General Electric Company on January 1 of this year because of ill health, died at his home in Erie on February 10.

Mr. Griswold was born in Erie in 1866 and was graduated from Sheffield Scientific School, Yale, in 1888. After two years of post graduate work he obtained the degree of M. E. Upon leaving college he became associated with the Griswold Manufacturing Company, of which he served as president for a number of years.

On November 11, 1911, he severed his connection with the Griswold Manufacturing Company to become acting manager of the Erie Works of the General Electric Company. He was made manager of the plant on December 12, 1912.

When Mr. Griswold retired as manager of the Erie Plant on January 1, H. L. R. Emmet succeeded him.

Samuel W. Miller Dies

Samuel Wylie Miller, consulting engineer of the Union Carbide & Carbon Research Laboratories, Inc., of Long Island City, N. Y., well known both in the United States and in Europe as a pioneer in oxyacetylene welding and an authority on its application, died on February 3 at his home in Hollis, Long Island, N. Y., at the age of 62.

Mr. Miller was instrumental in the development of welding by all processes scientifically well founded and was noted for his energetic insistence upon high quality and dependable workmanship. He was the donor of the Miller Medal, awarded annually by the American Welding Society for work of conspicuous merit in advancing the art and science of welding.

He is credited with having been among the first to visualize the possibilities of the oxyacetylene process and his important contributions to it were many. He wrote several books on the subject and was much sought after as a lecturer on welding at engineering meetings.

Mine and Smelter Supply Company

At a meeting of the board of directors of The Mine and Smelter Supply Company January 22, A. H. Seep, of Denver, Colo., was elected president. J. H. Fennessy is retiring as president after 25 years' service as the active head of the business, but continues as a director of the company.

Clark Grove was elected executive vice president and will move to Denver, Colo., where the general offices of the company will be located.

Mr. Seep and Mr. Grove have been associated with the company continuously for the past 27 years.

H. J. Gundlach will continue as general manager of the merchandising division of the company, in charge of the general supervision of the stores and warehouses at Denver, Colo.; Salt Lake City, Utah; and El Paso, Tex. The company distributes from those branches general machinery, mill supplies, electrical apparatus and supplies, assay and chemical equipment and supplies.

O. H. Johnson will continue in charge of the Marcy mill division of the company, which handles the manufacture, engineering and sales of Marcy mills, Wilfley tables and other products manufactured by the company.

A New York sales office will be maintained at 225 Broadway. J. P. Bonardi will continue as manager of the New York sales office.

New Linde Oxygen Plant

A new Linde oxygen producing plant, at 1241 North McLean Boulevard, Memphis, Tenn., started operations December 20, 1928.

The old Memphis plant, at 48 West McLemore Avenue, will be discontinued.

E. C. Heyman, superintendent of the old plant, will assume similar duties at the new plant.

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc.

ACETYLENE GAS
Prest-O-Lite Co., Inc.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co.

ACID, SULPHURIC
Irvington Smelt. & Ref. Works.

AERIAL TRAMWAYS
American Steel & Wire Co.

AFTERCOOLERS (Air)
Ingersoll-Rand Co.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co.
Sullivan Machinery Co.
Ingersoll-Rand Co.

AIR COMPRESSOR OILS
Standard Oil Co. (Ind.)

AIR FILTERS—Bag type
American Coal Cleaning Corpn.

AIR HEATERS
Westinghouse Electric & Mfg. Co.

AIR LIFT PUMPING
Sullivan Machinery Co.

ANNUNCIATOR WIRES & CABLES
Roebling's Sons Co., J. A.

ANNUNCIATOR WIRES & CABLES, INSULATED
American Steel & Wire Co.

ANTI-RUST OILS & GREASES
Standard Oil Co. (Ind.)

ARMATURE COILS & LEADS
General Electric Co.
Roebling's Sons Co., J. A.
Westinghouse Electric & Mfg. Co.

ARMORGRIDS
General Electric Co.

ASPIRATORS
American Coal Cleaning Corpn.

AUTOMATIC CAR & CAGER STOPS
Link-Belt Co.
Mining Safety Device Co.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Roberts & Schaefer Co.

AUTOMATIC CAR DUMPERS
Link-Belt Co.
Roberts & Schaefer Co.

AUTOMATIC FLAGGING SIGNALS
American Mine Door Co.

AUTOMATIC (Mine Doors, Trucks and Electric Switches)
American Mine Door Co.

AUTOMATIC MINE SWITCHES
Westinghouse Electric & Mfg. Co.

AUTOMATIC SWITCH THROWERS
American Mine Door Co.
Westinghouse Electric & Mfg. Co.

AUTOMOBILE CABLES
Roebling's Sons Co., J. A.

AUTOMOTIVE LUBRICANTS
Keystone Lubricating Co.

BAG TYPE AIR FILTERS
American Coal Cleaning Corpn.

BALLAST UNLOADER ROPES
Roebling's Sons Co., J. A.

BARS, STEEL
Carnegie Steel Co.
Timken Roller Bearing Co.

BATTERIES
E. I. du Pont de Nemours & Co.

BATTERIES, Armature
Westinghouse Electric & Mfg. Co.

BATTERIES, Blasting
Hercules Powder Co.

BATTERIES, DRY (for Bells, Buzzers, Signals, Blasting)
National Carbon Co., Inc.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co.
Westinghouse Electric & Mfg. Co.

BATTERY CHANGING STATION
Atlas Car & Mfg. Co.

BEARINGS (for all kinds of equipment)
Hyatt Roller Bearing Co.

BEARINGS, RADIAL
Timken Roller Bearing Co.

BEARINGS, TAPERED ROLLER
Timken Roller Bearing Co.

BEARINGS, THRUST
Timken Roller Bearing Co.

BELL CORD
Roebling's Sons Co., J. A.

BELT DRESSING
Standard Oil Co. (Ind.)

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Co.
Link-Belt Co.

BELTING, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

BINS (Coke and Coal)
The Jeffrey Mfg. Co.
Link-Belt Co.

BITS, Carbon (Diamonds) for Core Drill
R. S. Patrick.
Diamond Drill Carbon Co.

BITS, Diamond Drilling
R. S. Patrick.

BIT SHARPENERS
Sullivan Machinery Co.
Ingersoll-Rand Co.

BLACK DIAMONDS
Diamond Drill Carbon Co.
R. S. Patrick.

BLACK OILS
Standard Oil Co. (Ind.)

BLASTING ACCESSORIES
E. I. du Pont de Nemours & Co.

BLASTING CAPS
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

BLASTING MACHINES
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

BLASTING POWDER
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

BLASTING SUPPLIES
Hercules Powder Co.

BLASTING UNITS (Dry Battery)
National Carbon Co., Inc.

BLOWERS, CENTRIFUGAL
American Coal Cleaning Corpn.
General Electric Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

BLOWERS (or Compressors)
General Electric Co.

BLOWERS (Tubing)
The Jeffrey Mfg. Co.
Robinson Ventilating Co.

BLOWERS (Turbine)
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning Welding, Welding and Cutting
Oxweld Acetylene Co.

BLUE CENTER STEEL WIRE ROPE
Roebling's Sons Co., J. A.
Phillips Mine & Mill Supply Co.

BOND TERMINALS
American Mine Door Co.

BORTZ
R. S. Patrick.
Diamond Drill Carbon Co.

BRACES, GAUGE
Central Frog & Switch Co.

BRACES, RAIL
Central Frog & Switch Co.

BRACES, TRACK
Central Frog & Switch Co.

BRAZILIAN ROCK CRYSTAL
Diamond Drill Carbon Co.

BREAKER MACHINERY
Koppers-Rheolaveur Co.
Vulcan Iron Works.

BREAKERS
American Coal Cleaning Corpn.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Co.

BREAST MACHINES
Goodman Mfg. Co.

BRIQUETTING MACHINERY
Vulcan Iron Works.

BRUSHES (Carbon, Graphite and Metal Graphite for Electric Motors, Generators and Converters)
National Carbon Co., Inc.
Westinghouse Electric & Mfg. Co.

BUCKETS (Elevator)
Atlas Car & Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

CABLE COMPOUNDS
Standard Oil Co. (Ind.)

CABLE—DRILLING, WIRE
American Cable Co.

CABLE—ELEVATOR, MACHINE, ETC. (STEEL)
American Cable Co.

CABLE GREASE
Keystone Lubricating Co.

CABLE—HOISTING
American Cable Co.

CABLE — MINING (HAULAGE, SHAFT HOIST, MINING MACHINE, SLUSHER)
American Cable Co.

CABLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.

CABLES (Connectors and Guides)
American Mine Door Co.

CABLES, INSULATED
General Electric Co.
Roebling's Sons Co., J. A.

CABLES, SUSPENSION BRIDGE
American Cable Co.
Roebling's Sons Co., J. A.

CABLEWAYS
American Steel & Wire Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

CABLE—WIRE
American Cable Co.

CAGE DUMPERS, ROTARY
Link-Belt Co.
Roberts & Schaefer Co.

CAGES (Safety Appliances)
Connellsville Mfg. & Mine Supply Co.

CAGE STOPS & LOCKS
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAGERS, AUTOMATIC
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAGERS, AUTOMATIC & MANUAL
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAGES
Allis-Chalmers Mfg. Co.
C. S. Card Iron Works Co.
Connellsville Mfg. & Mine Sup. Co.
Link-Belt Co.
Vulcan Iron Works.

CAGES (Self-dumping)
Link-Belt Co.
Roberts & Schaefer Co.
Vulcan Iron Works.

CALCINERS
Vulcan Iron Works.

CALCIUM CARBIDE
Union Carbide Sales Co.

CARBON AND BORTZ
Diamond Drill Carbon Co.
R. S. Patrick.

CARBON FOR DIAMOND DRILLING
Diamond Drill Carbon Co.
R. S. Patrick.
Sullivan Machinery Co.

CARBON BURNING APPARATUS
Oxweld Acetylene Co.

CARBON ELECTRODES (for Electric Furnaces and Electrolytic Work)
National Carbon Co., Inc.
Westinghouse Electric & Mfg. Co.

CARBONS (for Arc Lamps, Blue Printing, Photographic)
National Carbon Co., Inc.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co.
National Carbon Co., Inc.

CARBON SPECIALTIES (Circuit Breaker Contacts, Packing Rings, Filter Plates, Tubes, etc.)
National Carbon Co., Inc.

CAR DUMPERS, GRAVITY & POWER
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAR DUMPERS (Rotary)
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAR FEEDERS
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAR HAULS
Goodman Mfg. Co.
Hockensmith Wheel & Mine Car Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

CAR PULLERS
Allis-Chalmers Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

CAR REPLACERS
Johnson Wrecking Frog Co.

CAR RERAILERS
Johnson Wrecking Frog Co.

CAR RETARDERS
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CARS OF ALL DESCRIPTION
Hockensmith Wheel & Mine Car Co.

CAR STOPS, AUTOMATIC & MANUAL
Link-Belt Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAR WHEEL LUBRICANTS
Keystone Lubricating Co.

CAR WIRE & CABLES
American Steel & Wire Co.
John A. Roebling's Sons Co.

CASTINGS
Goodman Mfg. Co.
Link-Belt Co.
The Jeffrey Mfg. Co.
Timken Roller Bearing Co.

CASTINGS, GRAY IRON
Link-Belt Co.
Vulcan Iron Works.

CASTINGS, OPEN HEARTH, STEEL
Vulcan Iron Works.

CASTINGS (Steel, Iron)
Vulcan Iron Works.

CAST STEEL FROGS
Central Frog & Switch Co.

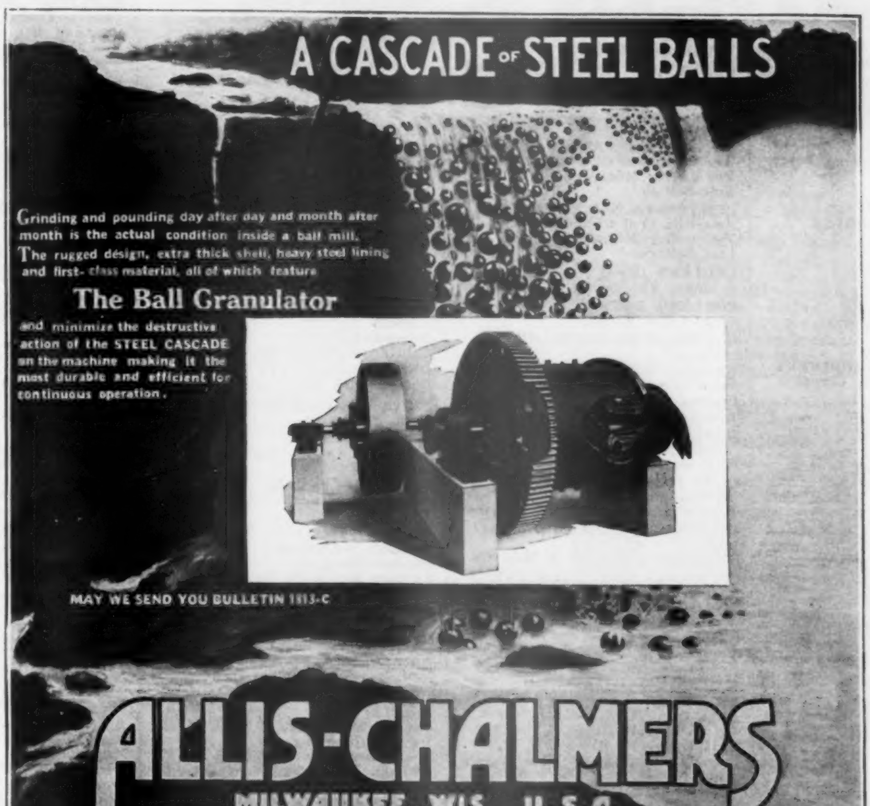
CHAINS
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co.
Morse Chain Co.

CHAINS, COAL CUTTING
Goodman Mfg. Co.
The Jeffrey Mfg. Co.

CHAINS, DRIVE
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.


De Laval Worm Gear
A Superior Speed Reducer for
Driving Conveyors
DE LAVAL
THIS 19½ to 1 ratio gear transmits 5 h.p. from an 860 r.p.m. motor to a coal conveyor. It is connected to the motor shaft and to the driven shaft by De Laval flexible couplings.
De Laval Steam Turbine Co., Trenton, N.J.
AD-1008


A CASCADE OF STEEL BALLS
Grinding and pounding day after day and month after month is the actual condition inside a ball mill. The rugged design, extra thick shell, heavy steel lining and first-class material, all of which feature
The Ball Granulator
and minimize the destructive action of the STEEL CASCADE on the machine making it the most durable and efficient for continuous operation.
MAY WE SEND YOU BULLETIN 1813-C
ALLIS-CHALMERS
MILWAUKEE, WIS. U.S.A.

ENGINES, STEAM
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
EXCAVATORS
Link-Belt Co.
EXHAUSTERS
American Coal Cleaning Corpn.
EXPLOSIVES
The E. I. du Pont Powder Co.
Hercules Powder Co.
FAN DRIVES
Link-Belt Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.
FANS, Man Cooling
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.
FANS, Turbine
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.
FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Robinson Ventilating Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.
FEEDERS
Hockensmith Wheel & Mine Car Co.
FEEDERS (Crossover, Kickback, Rotary and Dump)
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.
FEEDERS (Gravity)
American Coal Cleaning Corpn.
Link-Belt Co.
FEEDERS (Hand Operated)
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.
FEEDERS, ORE
The Jeffrey Mfg. Co.
Link-Belt Co.
FEEDERS (Reciprocating)
Link-Belt Co.
American Coal Cleaning Corpn.
FEEDERS (Semi-automatic)
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
FIBRE GREASES
Standard Oil Co. (Ind.)
FILTER CLOTH, WIRE
Ludlow Saylor Wire Co.
FILTERS (Dust)
American Coal Cleaning Corpn.
FIRE AND WEATHER-PROOF WIRE
Roebling's Sons Co., J. A.
FITTINGS—WIRE ROPE (Tru-Loc Brand Processed)
American Cable Co.
FITTINGS—WIRE ROPE (Thimbles, Clips, Sockets, Hooks, Shackles Turnbuckles)
American Cable Co.
FLASHLIGHTS AND BATTERIES (Mine Safety)
National Carbon Co., Inc.
FLOTATION MACHINES
Allis-Chalmers Mfg. Co.
FLOTATION OILS
Hercules Powder Co.
FLOW METERS
General Electric Co.
FLUX, WELDING
Oxweld Acetylene Co.
FORGINGS
Allis-Chalmers Mfg. Co.
FROGS
Central Frog & Switch Co.
FROGS AND SWITCHES
C. S. Card Iron Works Co.
Central Frog & Switch Co.
West Virginia Rail Co.
FURNACE OIL
Standard Oil Co. (Ind.)
FURNACES, Oil (for drill steel)
Ingersoll-Rand Co.
FURNACES, ROASTING
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.
GAS (Cutting, Welding)
Prest-O-Lite Co., Inc.
GAS (Nitrogen, Oxygen)
Linde Air Products Co.
GASOLINE
Standard Oil Co. (Ind.)
GAS ENGINE OILS
Standard Oil Co. (Ind.)
GAUGES, WELDING & CUTTING
Central Frog & Switch Co.
GAUGE RODS
Central Frog & Switch Co.

GAUGES, WELDING & CUTTING
Oxweld Acetylene Co.
GEAR COMPOUNDS
Standard Oil Co. (Ind.)
GEARS
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
GEARS, BEVEL
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
GEARS (Fabroil & Textolite)
General Electric Co.
GEARS, HERRINGBONE
Link-Belt Co.
Vulcan Iron Works.
GEARS, Machine Cut
Link-Belt Co.
Vulcan Iron Works.
GEARS, Moulded Tooth
Link-Belt Co.
Vulcan Iron Works.
GEARS, Silent Chain
Link-Belt Co.
Morse Chain Co.
GEARS, SPUR
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.
GEARS, WORM
The Jeffrey Mfg. Co.
GELATIN DYNAMITES
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.
GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.
GENERATORS, ACETYLENE
Oxweld Acetylene Co.
GLOVES, ASBESTOS
Oxweld Acetylene Co.
GOGGLES, WELDING
Oxweld Acetylene Co.
GRAPHITE GREASES
Standard Oil Co. (Ind.)
GREASE
Keystone Lubricating Co.
Standard Oil Co. (Ind.)
GREASE CUPS
Keystone Lubricating Co.
GRINDERS, Portable Pneumatic
Ingersoll-Rand Co.
GUARD RAIL CLAMPS
Central Frog & Switch Co.
GUY ROPES, GALVANIZED
American Steel & Wire Co.
Roebling's Sons Co., J. A.
HAMMERS, Calking, Chipping & Riveting
Ingersoll-Rand Co.
HANGERS
Link-Belt Co.
HANGERS (Insulated Trolley)
Ohio Brass Co.
HANGERS, SHAFT, DROP
Link-Belt Co.
HANGERS, SHAFT, POST
Link-Belt Co.
HANGERS, SHAFT, SELF-OILING
Link-Belt Co.
HAULAGE ROPE
American Steel & Wire Co.
Roebling's Sons Co., J. A.
HEADLIGHTS, ARC AND INCANDESCENT
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
HEATER CORD
Roebling's Sons Co., J. A.
HERRINGBONE GEAR DRIVES
Link-Belt Co.
HIGH EXPLOSIVES
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.
HOIST DRIVES
Link-Belt Co.
Vulcan Iron Works.
HOISTING ROPES
American Steel & Wire Co.
Connellsville Mfg. & Mine Supply Co.
Roebling's Sons Co., J. A.
HOISTS
American Steel & Wire Co.
Ingersoll-Rand Co.
Link-Belt Co.
Sullivan Machinery Co.

HOISTS, AIR
Ingersoll-Rand Co.
Sullivan Machinery Co.
HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
General Electric Co.
Goodman Mfg. Co.
Sullivan Machinery Co.
Vulcan Iron Works
HOISTS, PORTABLE
Ingersoll-Rand Co.
Sullivan Machinery Co.
HOISTS, Room
Vulcan Iron Works.
HOISTS, Room and Gathering
Goodman Mfg. Co.
HOISTS, Scraper-Loader
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.
HOISTS, STEAM
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co.
Vulcan Iron Works.
HOLDERS-ON RIVETING
Ingersoll-Rand Co.
HOOKS
Roebling's Sons Co., J. A.
HOOKS, WIRE ROPE
American Cable Co.
HOSE, AIR AND STEAM
Ingersoll-Rand Co.
HOSE, WELDING AND CUTTING
Oxweld Acetylene Co.
HYDRATORS, LIME
Vulcan Iron Works.
IGNITERS, Electric
Hercules Powder Co.
INCINERATORS
Vulcan Iron Works.
INCLINE FROGS
Central Frog & Switch Co.
INCLINE TRACK LAYOUTS
Central Frog & Switch Co.
INSULATORS, FEEDER WIRE
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
INSULATORS, SECTION
American Mine Door Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
INSULATORS (Porcelain)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
INSULATORS (Third Rail)
General Electric Co.
Ohio Brass Co.
INSULATORS (Trolley)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
INSULATED WIRE AND CABLE
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
KEROSENE
Standard Oil Co. (Ind.)
KEYSTONE GREASE
Keystone Lubricating Co.
KEYSTONE GREASE CUPS
Keystone Lubricating Co.
KEYSTONE SAFETY LUBRICATORS
Keystone Lubricating Co.
KILNS (Rotary)
Allis-Chalmers Mfg. Co.
Vulcan Iron Works.
KILNS, VERTICAL
Vulcan Iron Works.
LAMP CORD
American Steel & Wire Co.
Roebling's Sons Co., J. A.
LAMPS, ARC AND INCANDESCENT
General Electric Co.
Westinghouse Electric & Mfg. Co.
LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co.
LIGHT AND POWER PLANTS (Small)
Westinghouse Electric & Mfg. Co.
LIGHT STEEL ANGLES
Carnegie Steel Co.
LIGHT STEEL RAILS
Carnegie Steel Co.
West Virginia Rail Co.

LOADERS, Gravel and Sand
Joy Manufacturing Co.
Link-Belt Co.
LOADERS (Mine Car)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Myers-Whaley Co.
LOADERS, PORTABLE
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Myers-Whaley Co.
LOADERS, Snow
Joy Manufacturing Co.
LOADERS, Truck
Joy Manufacturing Co.
Link-Belt Co.
LOADERS, Wagon
Joy Manufacturing Co.
Link-Belt Co.
LOADING BOOMS
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
LOADING MACHINES
Connellsville Mfg. & Mine Supply Co.
Conveyor Sales Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Myers-Whaley Co.
LOCOMOTIVES, ELECTRIC
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.
LOCOMOTIVES, GASOLINE
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.
LOCOMOTIVES, RACK RAIL
Atlas Car & Mfg. Co.
Goodman Mfg. Co.
LOCOMOTIVES, STEAM
Vulcan Iron Works.
LOCOMOTIVES, STORAGE BATTERY
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.
LOCOMOTIVE SWITCHING & WRECKING ROPES
Roebling's Sons Co., J. A.
LOCOMOTIVES (Third Rail)
Atlas Car & Mfg. Co.
Goodman Mfg. Co.
LOCOMOTIVES, TROLLEY
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.
LONGWALL MACHINES
Goodman Mfg. Co.
Sullivan Machinery Co.
LUBRICANTS
Keystone Lubricating Co.
Standard Oil Co. (Ind.)
LUBRICATING DEVICES
Keystone Lubricating Co.
LUBRICATING GREASES
Keystone Lubricating Co.
LUBRICATING ENGINEERS
Keystone Lubricating Co.
LUBRICATORS
Keystone Lubricating Co.
MACHINE OILS
Standard Oil Co. (Ind.)
MACHINERY, TRANSMISSION (Power)
Allis-Chalmers Mfg. Co.
Link-Belt Co.
Morse Chain Co.
MANIFOLDS, OXYGEN
Oxweld Acetylene Co.
MAST ARM ROPE, Galvanized
Roebling's Sons Co., J. A.
MILL GREASES
Standard Oil Co. (Ind.)
MILLS, ROD & BALL
Allis-Chalmers Mfg. Co.
MILLS, STAMPS
Allis-Chalmers Mfg. Co.
MINE CAR AXLES
Hockensmith Wheel & Mine Car Co.
MINE CAR BEARINGS
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.

MINE CAR BOXES
Hockensmith Wheel & Mine Car Co.
MINE CAR FORGINGS
Hockensmith Wheel & Mine Car Co.
MINE CAR LUBRICANTS
Keystone Lubricating Co.
Standard Oil Co. (Ind.)
MINE CAR PARTS
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.
MINE CARS
Atlas Car & Mfg. Co.
C. S. Card Iron Works Co.
Enterprise Wheel & Car Corpn.
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.
MINE CAR WHEELS
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
MINE DOORS, AUTOMATIC
American Mine Door Co.
MINE LOCOMOTIVE CABLE
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
MINE TIES
Central Frog & Switch Co.
MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.
MINING EQUIPMENT
Allis-Chalmers Mfg. Co.
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINE CABLE
General Electric Co.
Roebling's Sons Co., J. A.
MINING MACHINES
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Sullivan Machinery Co.
MINING MACHINES (Electric)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINES (Government Approved)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
MINING MACHINERY
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINERY BEARINGS
Hyatt Roller Bearing Co.
MINING MACHINERY LUBRICANTS
Keystone Lubricating Co.
MINING MACHINE ROPES
American Cable Co.
MINING ROPES (Haulage, Shaft Hoist, Mining Machine, Slusher)
American Cable Co.
MOTOR OILS
Standard Oil Co. (Ind.)
MOTORS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.
MOTORS, Electric
Westinghouse Electric & Mfg. Co.
MOUNTED BOTTOM CUTTERS
Goodman Mfg. Co.
MOVING PICTURE CORD
American Steel & Wire Co.
Roebling's Sons Co., J. A.
NITROGEN GAS
Linde Air Products Co.
OILS
Standard Oil Co. (Ind.)
ORE, BUYERS AND SELLERS OF
Irvington Smelt. & Ref. Works.
OVERCUTTING MACHINES
Goodman Mfg. Co.
Sullivan Machinery Co.
OXYGEN GAS
Linde Air Products Co.
OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co.
PAVING BREAKERS
Ingersoll-Rand Co.
Sullivan Machinery Co.
PERFORATED METAL
Allis-Chalmers Mfg. Co.
PERMISSIBLES, Explosives
The E. I. Du Pont Powder Co.
Hercules Powder Co.
PETROLATUMS
Standard Oil Co. (Ind.)
PICKING TABLES
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
PIPE (Genuine Wrought Iron)
A. M. Byers Co.
PIPE (Wood)
Connellsville Mfg. & Mine Supply Co.
PNEUMATIC COAL SEPARATING MACHINERY
American Coal Cleaning Corp.
PNEUMATIC SIZING MACHINERY
American Coal Cleaning Corp.
PNEUMATIC TOOL
Ingersoll-Rand Co.
PNEUMATIC TOOL LUBRICANT
Standard Oil Co. (Ind.)
PORTABLE TRACK
Central Frog & Switch Co.
PORTABLE TURNOUTS
Central Frog & Switch Co.
POWDER, BLASTING
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.
POWER CABLES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
POWER SHOVELS
Link-Belt Co.
POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.
Westinghouse Electric & Mfg. Co.
PREHEATING APPARATUS
Oxweld Acetylene Co.
PRESSURE GUN GREASE
Standard Oil Co. (Ind.)
PROSPECTIVE DRILLS
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.
Pennsylvania Drilling Co.
PULLEYS
Link-Belt Co.
PULLEYS, CLUTCH, FRICTION
Link-Belt Co.
PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Co.
PUMPS, Acid Resisting
Ingersoll-Rand Co.
PUMPS, AIR LIFT
Ingersoll-Rand Co.
Sullivan Machinery Co.
PUMPS, Boiler Feed
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.
PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, DEEP WELL
Ingersoll-Rand Co.
PUMPS (Electric)
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
Westinghouse Electric & Mfg. Co.
PUMPS, Fire
Ingersoll-Rand Co.
PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co.
PUMPS, Inclined Shaft
Ingersoll-Rand Co.
PUMPS, MINE
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, Sinking
Ingersoll-Rand Co.
PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co.
PUMPS, POWER
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, VACUUM
Ingersoll-Rand Co.
PUNCHES, Drill Steel
Ingersoll-Rand Co.
Sullivan Machinery Co.
QUARRYING MACHINERY
Ingersoll-Rand Co.
Sullivan Machinery Co.
QUARTZ CRYSTAL
Diamond Drill Carbon Co.
RAIL BONDS
American Steel & Wire Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
RAIL BRACES
Central Frog & Switch Co.
RAILWAY SUPPLIES
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
RAMMERS, Pneumatic
Ingersoll-Rand Co.
RECEIVERS, AIR
Ingersoll-Rand Co.
REGULATORS, Welding and Cutting, Compressed Gas
Oxweld Acetylene Co.
REHEATERS, Air
Ingersoll-Rand Co.
REINFORCING BARS
West Virginia Rail Co.
RESCUE APPARATUS
Link-Belt Co.
RETARDERS
Mining Safety Device Co.
Roberts & Schaefer Co.
RIVER CROSSING SUSPENSION WIRE, Galvanized
Roebling's Sons Co., J. A.
ROCK-DISPOSAL EQUIPMENT
Link-Belt Co.
Roberts & Schaefer Co.
ROCK DRILLS
Ingersoll-Rand Co.
ROCK DUSTING EQUIPMENT
American Mine Door Co.
RODS, WELDING
Ohio Brass Co.
Oxweld Acetylene Co.
ROLLER BEARINGS
Enterprise Wheel & Car Corporation.
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.
ROLLERS
C. S. Card Iron Works Co.
ROLLS (Crushing)
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
ROPE
American Steel & Wire Co.
ROPE GREASE
Keystone Lubricating Co.
ROPE, MINING (Haulage, Shaft Hoist, Mining Machine, Slusher)
American Cable Co.
ROPE, SWITCH WIRE
American Cable Co.
ROPE, TOWING WIRE
American Cable Co.
ROPE, TRANSMISSION
American Steel & Wire Co.
Roebling's Sons Co., J. A.
ROPE, WIRE
American Steel & Wire Co.
Roebling's Sons Co., J. A.
ROPE, WIRE (Crescent Brand Ordinary)
American Cable Co.
ROPE, WIRE (Plain or Galvanized)
American Cable Co.
ROPE, WIRE (Tru-Lay Brand Preformed)
American Cable Co.
ROTARY COOLERS
Vulvan Iron Works.
ROTARY DRYERS
Vulcan Iron Works.
ROTARY DUMPS
C. S. Card Iron Works Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.
ROTARY ROASTERS
Vulcan Iron Works.
RUNNING ROPE, Galvanized
American Steel & Wire Co.
Roebling's Sons Co., J. A.
SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co.
SAFETY FUSE
Hercules Powder Co.
SAFETY FUSE & WIRES—LEADING & CONNECTING
E. I. Du Pont de Nemours & Co.
SAFETY LUBRICATORS
Keystone Lubricating Co.
SAND DRYERS
Roberts & Schaefer Co.
SASH CORD
Roebling's Sons Co., J. A.
SAWS (Air)
Ingersoll-Rand Co.
SCRAPER LOADERS
Goodman Mfg. Co.
Sullivan Machinery Co.
SCREEN BARS
Phillips Mine & Mill Supply Co.
SCREENS (Anti-Gravity)
American Coal Cleaning Corpn.
SCREENS, ARCH-CRIMP
Ludlow Saylor Wire Co.
SCREENS, DOUBLE CRIMPED
Ludlow Saylor Wire Co.
SCREENS, HORIZONAL
Link-Belt Co.
Roberts & Schaefer Co.
W. S. Tyler Co.
SCREENS, PERFORATED METAL
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
SCREENS, REK-TANG
Ludlow Saylor Wire Co.
SCREENS, REVOLVING
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
SCREENS, SHAKER
C. S. Card Iron Works Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co.
SCREENS (Vibrating)
American Coal Cleaning Corpn.
Link-Belt Co.
W. S. Tyler Co.
SCREENS & WASHERIES
Koppers-Rheolaveur Co.
Link-Belt Co.
Roberts & Schaefer Co.
SCREENS, WOVEN WIRE
Ludlow Saylor Wire Co.
SEIZING STRAND, GALVANIZED
Roebling's Sons Co., J. A.
SHACKLES, WIRE ROPE
American Cable Co.
SHAFT HOIST ROPES
American Cable Co.
SHARPENERS, DRILL
Ingersoll-Rand Co.
Sullivan Machinery Co.
SHEAVES
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
Roebling's Sons Co., J. A.
Vulcan Iron Works.
SHEAVE WHEELS
Hockensmith Wheel & Mine Car Co.
Vulcan Iron Works.
SHORTWALL MACHINES
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Hyatt Roller Bearing Co.
Sullivan Machinery Co.
SHOVELS, ELECTRIC
Myers-Whaley Co.
SHOVEL—ELECTRO-HYDRAULIC
Goodman Mfg. Co.
SIGNAL WIRES AND CABLES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
SIGNS (Mine)
Stonehouse Signs, Inc.
SINKERS, ROCK DRILL
Ingersoll-Rand Co.
SKIPS
Allis-Chalmers Mfg. Co.
Atlas Car & Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Roberts & Schaefer Co.
Vulcan Iron Works.
SKIP LOADING EQUIPMENT
Atlas Car & Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

SLABBING MACHINES
Goodman Mfg. Co.

SLINGS, WIRE ROPE
American Cable Co.

SLUSHER ROPES
American Cable Co.

SMELTERS
Irvington Smelt. & Ref. Works.

SOCKETS, Open and Closed
Roebling's Sons Co., J. A.

SOCKETS, WIRE ROPE
American Cable Co.

SPECIAL MACHINERY
Vulcan Iron Works.

SPEED REDUCERS, DOUBLE
Link-Belt Co.
Morse Chain Co.

SPEED REDUCERS, SINGLE
Link-Belt Co.
Morse Chain Co.

SPIKES
West Virginia Rail Co.

SPLICE BARS (Plain and Angle)
Carnegie Steel Co.
Central Frog & Switch Co.
West Virginia Rail Co.

SPLICE, CABLE
American Mine Door Co.
Ohio Brass Co.

SPLICE, INSULATOR
American Mine Door Co.

SPLICE, TROLLEY WIRE
General Electric Co.
Ohio Brass Co.

SPLICERS, TROLLEY
American Mine Door Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

SPROCKETS, CLAMP HUB
Link-Belt Co.
Morse Chain Co.

SPROCKETS, COMPENSATING
Link-Belt Co.
Morse Chain Co.

SPROCKETS (Shearing Pin)
Link-Belt Co.
Morse Chain Co.

SPROCKETS, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

SPROCKETS, SPRING
Link-Belt Co.
Morse Chain Co.

SPUR GEAR DRIVES
Link-Belt Co.

STARTER CABLES
Roebling's Sons Co., J. A.

STEAM CYLINDER OILS
Standard Oil Co. (Ind.)

STEEL, ALLOY
Timken Roller Bearing Co.

STEEL CROSS TIES
Carnegie Steel Co.
West Virginia Rail Co.

STEEL, ELECTRIC FURNACE
Timken Roller Bearing Co.

STEEL, HOLLOW AND SOLID DRILL
Ingersoll-Rand Co.

STEEL, NICKEL
Timken Roller Bearing Co.

STEEL, NICKEL, MOLYBDENUM
Timken Roller Bearing Co.

STEEL, OPEN HEARTH
Timken Roller Bearing Co.

STEEL, REINFORCING
American Mine Door Co.

STEEL, SHAPES, PLATES, BARS, ETC.
Carnegie Steel Co.

STEEL, Special Analysis
Timken Roller Bearing Co.

STEEL TIES AND REINFORCEMENTS
Carnegie Steel Co.
West Virginia Rail Co.

STOPERS, ROCK DRILL
Ingersoll-Rand Co.
Sullivan Machinery Co.

STORAGE BATTERY LOCOMOTIVES
Atlas Car & Mfg. Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

STRAND
American Steel & Wire Co.
Roebling's Sons Co., J. A.

SWITCHBOARD WIRE AND CABLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.
Westinghouse Electric & Mfg. Co.

SWITCHBOARDS, POWER
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

SWITCHES
C. S. Card Iron Works Co.
Central Frog & Switch Co.

SWITCHES, ALTERNATING
Mining Safety Device Co.

SWITCHES (Disconnecting and Electric)
General Electric Co.
Westinghouse Electric & Mfg. Co.

SWITCHES AND FROGS, TROLLEY
American Mine Door Co.
Central Frog & Switch Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

TACKLE BLOCKS
Roebling's Sons Co., J. A.

TELEGRAPH AND TELEPHONE WIRES AND CABLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.

TELEPHONE CORDS
American Steel & Wire Co.
Roebling's Sons Co., J. A.

THIMBLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.

TIES (Steel, Mine)
Carnegie Steel Co.
Central Frog & Switch Co.

TILLER ROPE
Roebling's Sons Co., J. A.

TIMBER PRESERVING EQUIPMENT
Allis-Chalmers Mfg. Co.

TIMBERS, STEEL MINE
Carnegie Steel Co.

TIPPLES
American Coal Cleaning Corp.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

TIPPLE EQUIPMENT
American Coal Cleaning Corp.
C. S. Card Iron Works Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

TIPPLE TRACK
Central Frog & Switch Co.

TIRE WIRES
Roebling's Sons Co., J. A.

TOOLS, Blacksmiths (for drill steel)
Ingersoll-Rand Co.

TORCHES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co.

TRACK BRACES
Central Frog & Switch Co.

TRACK EQUIPMENT
Carnegie Steel Co.
Central Frog & Switch Co.
C. S. Card Iron Works Co.
West Virginia Rail Co.

TRACK LAYOUTS (Industrial)
Central Frog & Switch Co.

TRACKS, PORTABLE, RAIL, ETC.
Carnegie Steel Co.
Central Frog & Switch Co.
West Virginia Rail Co.

TRACK (Portable)
Carnegie Steel Co.
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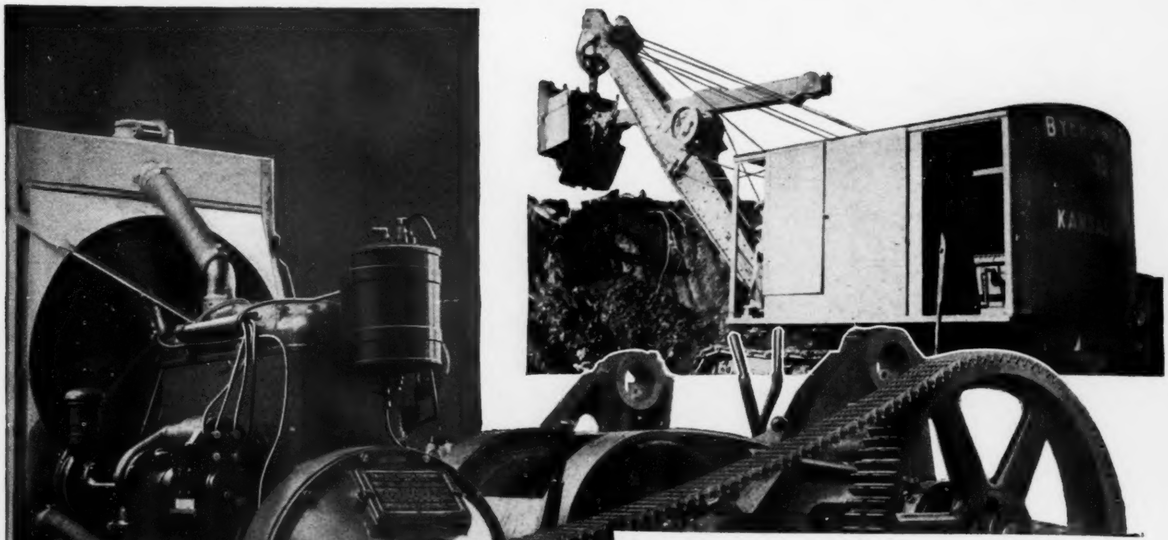
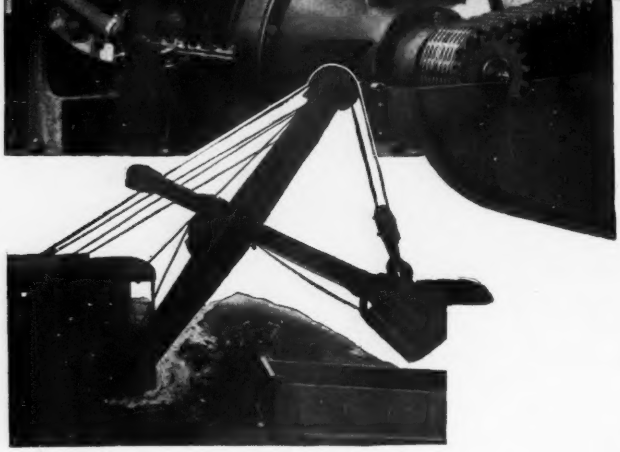

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